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# SOME POINTS IN CONNECTION WITH GASTRIC SURGERY

BY E. STANMORE BISHOP, F. R. C. S., MANCHESTER, ENGLAND

Honorable Surgeon Ancoats Hospital; Gynecological Surgeon, Jewish Hospital, Manchester; Vice-President Manchester Medical Society; Member of Council, Obstetrics; Secretary Royal Medical Society, London

DURING the last decade many alterations have taken place in the prevailing ideas with regard to the stomach. The conditions revealed during operation and perhaps still more those disclosed by the use of the X-rays have added greatly to the information available on the subject, whilst the results following the various operations on this organ have almost revolutionized previous teaching. Much, also, is due to the work of such pioneers as Kehr, Herz, Mayo Robson, Moynihan, the Mayos, and Paterson, who have not only shown what can be done, but, what is at least equally important, what should be avoided.

Even ideas as to the shape of the living stomach have had to be recast; the classic representation of the post-mortem stomach with its smooth outline and characteristic shape will no longer serve; even the appearances seen during operation taken by themselves are misleading, and it is only the possibility of watching the bismuth-outlined organ in action by means of the Roentgen rays that has enabled surgeons and physiologists alike to form a correct idea of the living and active second section of the digestive tract.

Radiograms of the stomach are so frequently called for only when alterations in its size, shape, or character have occurred, that it is useful to have some representation of the "normal" stomach, by the differences from which these changes may be estimated. I have therefore had a radiogram taken from the abdomen of a girl of sixteen, who was in perfect health, having first fed her with bismuthised porridge. Unfortunately it has been found impossible to reproduce this and two succeeding plates direct from the negative or from prints, owing to special difficulties. Their essential features

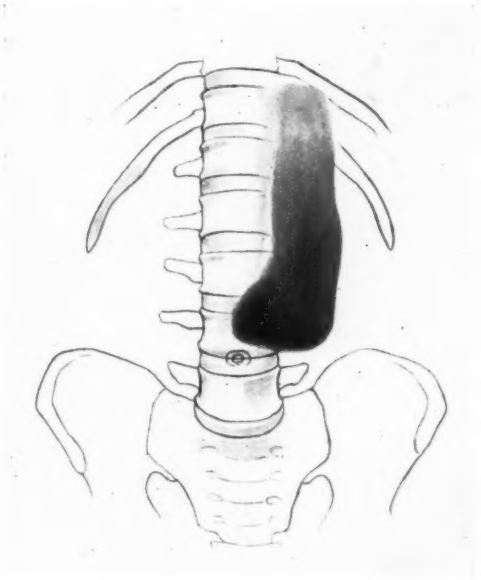

Fig. 1. Shows the most usual form of the normal stomach in the upright position of the patient.

are however shown in the drawings from them by Miss E. Loise Bradbury, who has succeeded in giving a very clear idea of what can be seen in the originals. Fig. 1 shows the most usual form, a long, almost straight tube, curved abruptly below and occupying a position much lower and more central than used to be described, lying mainly on the left side of the spinal column, but having a clear space on its left, right up to the diaphragm, which can be defined above, which space is occupied by the splenic flexure and descending colon; this is even better shown in Fig. 2. At the upper extremity of the gastric tube is a collection of air immediately below the diaphragm in the cardiac end of the stomach, more clearly defined in radiogram C. This air space is constantly seen in all stomachs examined in the erect position; when the patient is lying down the air of course occupies that portion of the stomach which is uppermost and that in the dorsal position is naturally nearest to the anterior abdominal wall and therefore no longer apparent. In the erect posture the lower border of the normal stomach lies at about the umbilical level or slightly below, and curves upwards to the (patient's) right where the shadow ends in the pyloric antrum, not yet distended and so on into the pylorus. The stomach has thus the appearance of a piece of large intestine hanging almost vertically from the diaphragm; as it is filled from above the level of the food in the stomach very rarely alters, the additions producing a widening of the tube, but the air-containing portion always remaining clear. Two other forms of stomach have been described, but this is by far the most frequently encountered. In Fig. 2, the rectum and descending colon had been previously distended by air and the duplications of the mucosa forming the well-known sacculations of the large intestine are well indicated.

Both the cæcum in the left lower corner and the splenic flexure on the right of the drawing contain air; the stomach is filled with bismuthised food. At the cardiac extremity on the right contractions are seen commencing, which have thrown the stomach wall into curious and radiating folds. Fig. 3 forms an admirable contrast to the first two; at the same time cer-

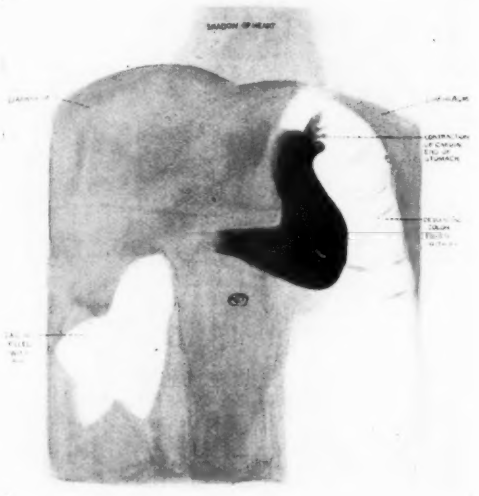

Fig. 2. Shows the position of the splenic flexure with reference to the stomach and diaphragm.

tain features are perhaps still more clearly demonstrated. This was taken from a patient with a dilated atonic stomach whose symptoms had lasted for ten years. The pear shaped air cavity at the cardiac extremity is clearly seen. The vertical character of the stomach in the upright position, and the extremely low locality in which the pyloric antrum may be found, together with the usual level of the food may all be recognised in this drawing. It is perhaps worthy of note, en passant, that improvement in this case after gastroenterostomy was delayed for five months, with the exception of relief from pain, which was almost immediate. The operation was done in March, 1908. General improvement did not show itself until August in the same year, though later it was steady and marked.

The differences in shape, size, and position in the erect and supine positions must especially be remembered when a stomach is examined with the fluorescent screen after gastroenterostomy. Before the operation observations will probably have been taken with the patient erect, but it is difficult to repeat them in this attitude soon after the interference; if then a photograph is taken in the dorsal position, so marked an apparent improvement

will be noted both in the size and position of the stomach that an entirely false idea may be formed of the value of the work done unless the operator is previously aware of this effect; and this is of course especially the case when some dilatation has already been produced by the course of the disease.

Photography moreover has, like everything else, its own limitations. It is only possible to reproduce the actual state of affairs at a given moment. In order to appreciate the changes which occur in the shape of the stomach during digestion or the passage of food, either through the natural or an artificial opening, observations must be continuously made through the screen and it is difficult to follow these for any length of time, partly because of the strain upon one's own eyes, partly because it is inadvisable to expose any patient, more especially one enfeebled by illness, to a prolonged contact with X-rays, and partly because the tubes used rapidly deteriorate with continuous use and their light becomes ineffective. It will be apparent that many difficulties thus surround attempts to obtain a proper estimation of the results produced by gastroenterostomy, more especially during the period immediately following the formation of the new opening, and it is therefore not surprising that different views have been formed and expressed as to the effects of this proceeding.

Some surgeons look upon gastroenterostomy as essentially an operation for drainage of the overdistended and constantly irritated stomach, irritated by the prolonged retention of hyperacid contents which by their very acidity produce spasm and tonic contraction of the pyloric sphincter and so still further retention; or by the decomposition of the food taken and the consequent production of toxic or chemical irritants. It is scarcely necessary to refer to Pavlov's experiments or to Paterson's observations, both being so well known, which show that the presence of acid stomach contents in the duodenum reflexly excites the alkaline pancreatic and biliary secretions which pour in to neutralize them and at the same time checks the further secretion of the gastric juice itself. By means of the artificial opening the gastric contents are enabled to reach the upper part of the intestinal canal much earlier than would otherwise be the case; the pancreatic juice is secreted sooner, the excessive gastric secretion is diminished and by all these factors and still more by the elimination of the repeated and powerful contractions which strive to overcome the sphincteric contraction, the gastric walls obtain the rest and freedom from prolonged irritation they so much need.

Other authorities consider that gastroenterostomy simply provides a safety valve preventing undue dilatation or constituting a bypass in those cases in which actual obstruction at the pyloric orifice is present, due to contraction of an ulcer or the presence of a neoplasm. They point to what must now be admitted as an accepted fact, that the beneficial results of gastroenterostomy are most marked in those instances in which the natural route is more or less closed and to radiographic observations in which the bismuth-laden food has been seen to pass over the artificial opening as though it did not exist, taking by preference the original pathway through the duodenum; they argue that if the new exit really constituted a drain this could not occur, but that in all cases food would not be retained in the stomach, but would simply pass directly through into the small intestine. Analogy with what occurs in other canals in the body under similar circumstances, however, suggests that both modes of action may be present but at different times; it is only necessary to refer to the effect of perineal section in cases of urethral stricture. Numerous other instances will present themselves to the minds of all surgeons.

Thus the action of such an artificial opening may not be the same at all periods of time after its formation. In the case of a urethral stricture for which a perineal opening has been made, urine will escape freely by the new route for several days, constituting a true drain; during this time, even if nothing is done in the way of mechanical dilatation, the rest so obtained for the stricture will of itself tend to open the normal passage by eliminating the spasm due to the persistent forcing of the fluid through the irritated segment of the urinary tract and the consequent swelling of the mucosa. When that swelling and irritation have thus been reduced and the canal is

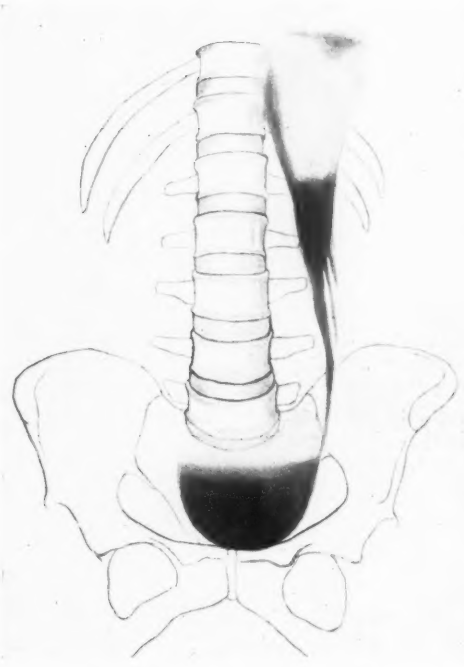

Fig. 3. An atonic and dilated stomach. Above the cardiac air chamber is seen. Most of the bismuthised food has collected in the fundus, the lower end of which reaches the symphysis pubis.

therefore recovering to some extent its normal calibre, some urine will again pass though it and the relative amount will slowly become greater, less and less passing through the perineum. The operative opening now no longer acts as a drain, but becomes a safety-valve. This illustration of what occurs in a part open to inspection may serve to some extent, at least, to suggest what will probably take place in a tube such as the digestive tract, which, when the operation is over, is once more withdrawn from observation by the closure of the abdominal wall.

In order, if possible, to obtain some data on this matter, observations with the Roentgen rays have been made by Dr. Barclay, the head of the radiographic department at Ancoats Hospital and myself on certain patients upon whom gastroenterostomy has been done for gastric ulcer and the consequent pyloric obstruction due to contraction following the healing of such ulcers. The problem is, as I have said, a somewhat complicated one and our observations are, as we are well aware, merely beginning; not only are the various difficulties already mentioned present, but it appeared probable that the action of the new opening might vary with the kind of food which the patient was directed to take. Farinaceous food is normally, as is well known, not retained in the stomach for so long a time as proteid foods, and in the patient's own interests it is not advisable to give proteid foods except in a liquid state, which prevented accurate comparison, during the earlier period after operation. All, therefore, that could be done was to note the route by which farinaceous foods, which constitute the usual diet allowed to such patients, left the stomach during the earlier periods, its rate of exit, and how far both became modified as time went on. In one case an attempt was made to estimate the difference produced by giving carbohydrate and proteid foods some time after operation.

Whilst, therefore, it is evident that these observations are much too few for any conclusions to be based thereon, they appear to be of sufficient interest to justify their being recorded.

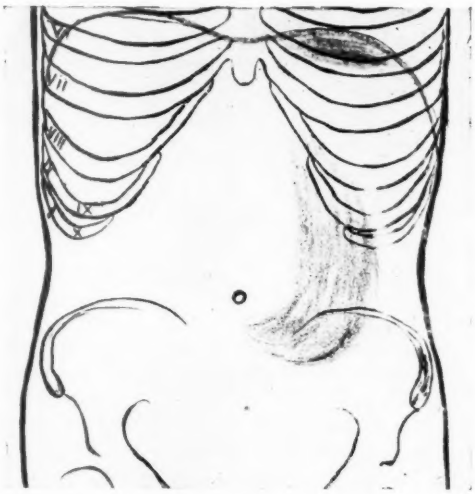

Fig. 4. Stomach one month after operation. Observation 1 minute after feeding.

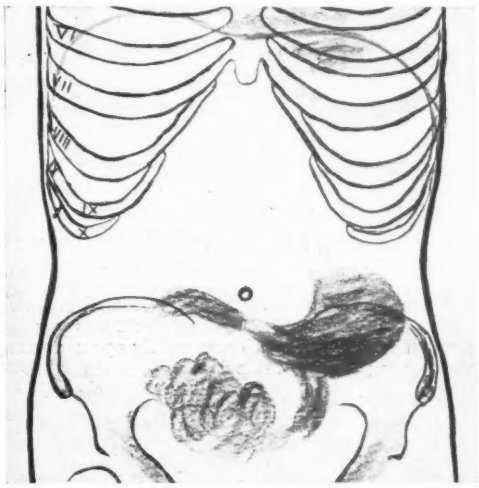

Fig. 5. Same case. Observation 15 minutes after feeding.

All the succeeding illustrations are reproductions of drawings made by Dr. Barclay on the fluorescent screen at the moment of observation. These appeared to be preferable to photographs as no time was thereby lost and the details being observed by a trained eye could be separated from the unessential shadows which might render a photograph confusing to those unaccustomed to interpret them.

The first series refer to the case of a woman of forty years of age upon whom posterior gastrojejunostomy was done for gastric ulceration, Dec. 29, 1907. In this case the pylorus was not much obstructed. Observations were made Jan. 29, 1908, or one month later.

In Fig. 4, the bismuthised (carbohydrate) food had been taken one minute before the drawing was made; the food was entirely contained in the stomach; none had passed through either the pylorus or the artificial stoma.

Fig. 5. Taken at the end of 15 minutes. Some gastric contents were passing through the pylorus, but the majority through the stoma, and already the upper coils of the jejunum were filling.

Fig. 6. Taken at the end of thirty-five minutes. A very interesting stage had been reached; the stomach contained much less; the amount passing through the pylorus was very slight whilst the stoma had apparently closed, no longer permitting any passage, though the bismuth here was shown as in a funnel, the apex directed toward the intestine. A good deal could be seen in the upper intestinal coils below the stomach but that portion of gut immediately below the stoma was clear; it would seem as though by contraction of the gastric walls some kind of sphincteric action had been produced, limiting the amount discharged at any one time into the intestine and retaining the rest within the stomach until the gut had disposed of the amount previously received.

It will be noted that a month had elapsed in this case between the operation and these observations.

In the next series an even longer period had been allowed to intervene; gastrojejunostomy was done on August 16, 1907, and the screen drawings were not made until February 4, 1908, nearly six months later. The time between the three observations of this series was the same as, and the food given was identical with, that in the first series; the stomach was, however, more atonic. No doubt this had much to do with the fact that the escape was much less rapid, but taken in conjunction with the other cases mentioned, the distance of time between interference and examination would appear to have had even more effect.

Fig. 7. One minute after feeding. The stomach still contained all the material seen; both stoma and pylorus were closed.

Fig. 8. Ten minutes after food. The pylorus remained closed whilst bismuth was freely issuing by

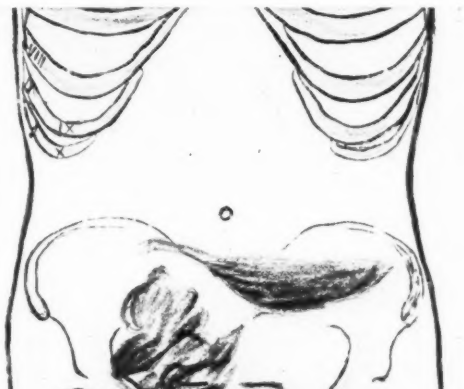

Fig. 6. Same case. Observation 35 minutes after feeding. Note the clear space between the bismuth still in the stomach and that in the intestines.

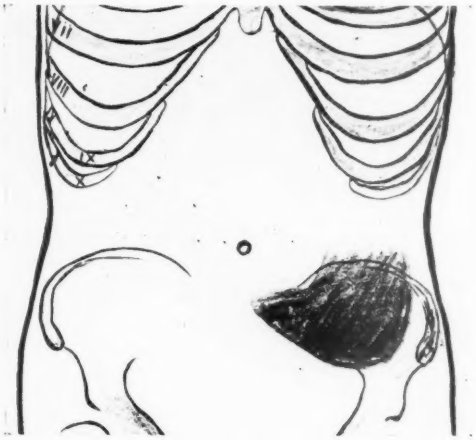

Fig. 7. Stomach six months after operation. Observation one minute after feeding.

the stoma; it had not, however, penetrated as far into the small intestine as in the last case.

Fig. 9. Taken at the end of thirty-five minutes. No food had passed by the pylorus; the upper part of the small intestine contained bismuth but nothing like so much was seen in it as in the companion picture, Fig. 6.

In the next two drawings the passage of the same (carbohydrate) food was observed upon a patient at an interval of two months; this

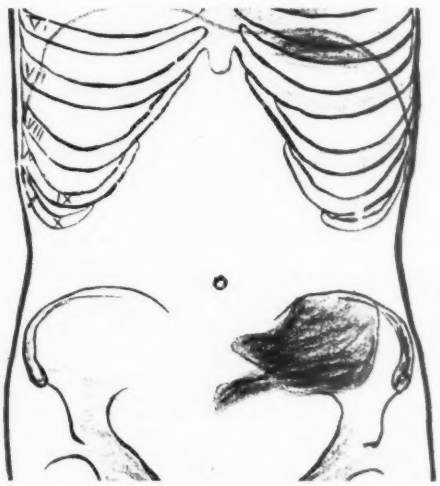

Fig. 8. Stomach six months after operation. Observation ten minutes after feeding.

was a man of 59 years of age whose stomach had well retained its tone and in which a well-marked ulcer was found at the time of operation on the anterior wall close to the pylorus. Gastrojejunostomy was done on November 1, 1907; the first observation (Fig. 7) was taken on Jan. 12, 1908, and the second (Fig. 8) was taken on March 3, 1908. The same food was given him on both dates and observations were made three minutes afterwards in both cases.

Fig. 10. January 12, 1908. The stomach was well defined, full of bismuth; a fair amount was pouring through the stoma, which was widely open; nothing was passing through the pylorus.

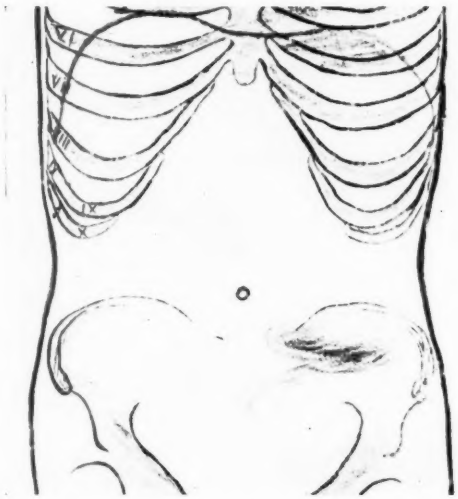

Fig. 9. Stomach six months after operation. Observation 35 minutes after feeding.

Fig. 11. March 3, 1908. The stomach was well defined; its fundus lay lower than in the previous figure and bulged downwards; the stoma was obviously open and bismuth was beginning to pass, but whilst in Fig. 10 the upper intestine already contains sufficient to render its contour visible, in this drawing little or none can be seen in the gut.

With a view to determine whether the kind of food given had any effect on the action of the stoma, to this patient was given on March 1, two days previous to the observation recorded in Fig. 11, a meal of proteid food, and as it was anticipated that this would be retained longer in the stomach than one of carbohy-

drate, twenty minutes were allowed to elapse before an observation was taken; as had been expected the difference was marked; in Fig. 11 with carbohydrate food escape through the stoma was beginning at the end of three minutes, whilst the same stomach when containing proteid food was found to be entirely closed at the end of twenty minutes, as shown in Fig. 12.

As confirming the theory that the time which elapses after gastroenterostomy modifies the action of the stoma, transforming it from a drainage opening in the earlier stage to one acting as a safety valve at later periods, another observation taken from another patient six months after operation may be of interest;

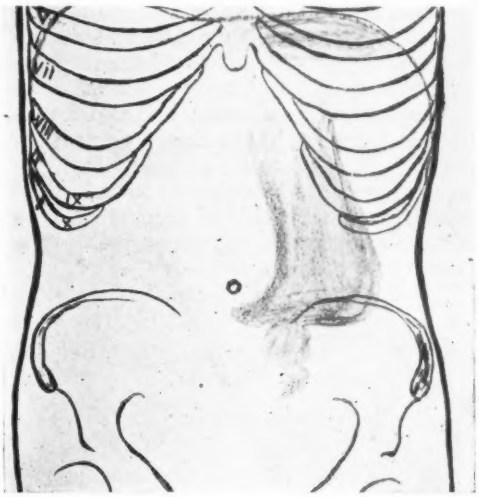

Fig. 10. Stomach two months after operation. Observation three minutes after feeding. Carbohydrate food.

this was a young woman of 20, whose recovery from a most emaciated condition after operation was very noticeable. In this case a carbohydrate meal was given and the stomach examined at the end of 30 minutes; the organ was well distended and its outline defined, but nothing had escaped by the stoma and the intestines were quite clear (Fig. 13).

In the earlier cases perhaps unnecessary caution had been shown in order not to disturb the healing process between the united viscera; it seemed possible that the introduction

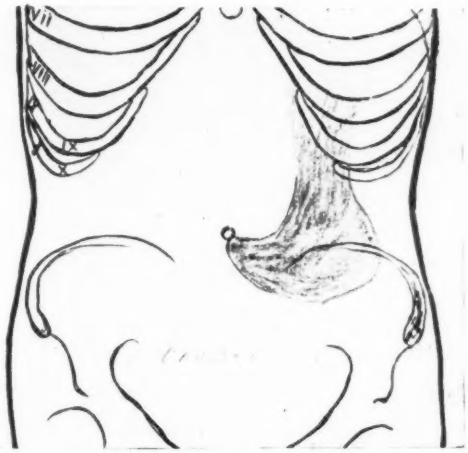

Fig. 11. The same stomach four months after operation. Observation three minutes after feeding. Carbohydrate food.

of a dose of bismuth large enough to give a definite shadow might do harm, and therefore in the cases already cited no examination was made until a month had elapsed; but it was evident that such examintions, though they might show the trend of events, could give no direct evidence as to what actually took place

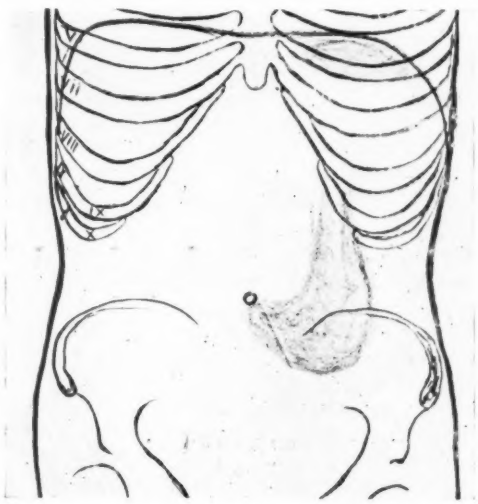

Fig. 12. The same stomach filled with proteid food, four months after operation. Observation 20 minutes after feeding.

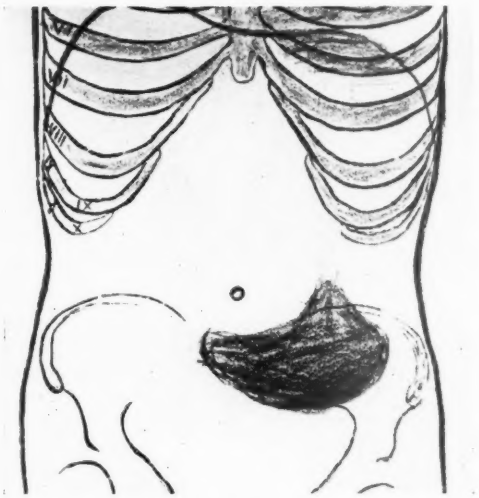

Fig. 13. Stomach six months after operation. Observation thirty minutes after feeding.

during the first few days; therefore, as in each case, with one exception, recovery was uneventful, and more and more confidence consequently was felt on the technique adopted, it was determined that an attempt should be made at the end of eight days when union, although not yet complete, might be expected to be fairly firm.

The case selected for this observation was that of a man aged 45, sent by Dr. Wilde Smith, of Ardwick, whose pylorus was almost entirely closed by the strongly contracted scar of a deep ulcer on the anterior wall. On the eighth day after gastrojejunostomy, half a teacupful of thin porridge well mixed with bismuth was given and ten minutes later a screen picture was made. The result is shown in Fig. 14; but this scarcely gives a full idea of what was seen; the material was escaping in large "gulps" entirely through the stoma; the "gulps" rapidly succeeded one another and the upper intestine so quickly filled that before a plate could be placed in position it had become hopeless to expect a clear picture.

As has been already said, these figures and drawings represent merely tentative and preliminary work, but they may be sufficient to suggest new lines of investigation.

The armamentarium of the gastric surgeon, judging from the instrument makers' catalogues, is not yet a very extensive one. For gastroenterostomy, the only clamp which holds both viscera in a constant relation to one another during suture is Moynihan's, which is needlessly large and heavy, and Carwardine's, which is better suited, and indeed is intended for intestinal anastomosis. During many years, it has been my custom to visit from time to time the more noted English surgical clinics in which abdominal surgery is done, and most operators I have observed use some form of clamp; one only, Mr. C. J. Bond, of Leicester, prefers to depend upon an assistant's fingers both for occlusion and approximation. He thinks that the use of a clamp interferes with the blood supply to the line of union and determines venous stasis in the tissues beyond the clamp; everyone also has noted the tendency of the mucosa on division to roll out and cover the edges of the outer coats; this also, he believes, is increased by the use of clamps; but whilst both objections are probably true, they do not appear to prevent the sound union desired, and the additional security afforded by some appliance is so great as probably to more than counterpoise these drawbacks. Of all the clamps I have seen, the best is one

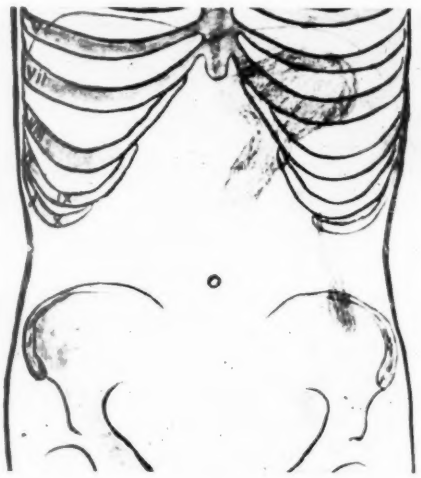

Fig. 14. Stomach eight days after operation. Observation ten minutes after feeding.

with three blades, the central one lying between the two viscera to be united, and the two outer ones grasping their respective viscus and compressing it against the middle blade; the name of the inventor I have not been able to ascertain, but the instrument comes from Germany. I have had the central bar made oval, so as to present no angles to the tissues gripped, and the outer bars so made that their tips come together sooner than the rest; as in the original, the whole instrument is curved on the flat, thus permitting the placing of gauze beneath and around the tissues to be united.

The instrument is shown in Fig. 15.

But it is in gastrectomy that the absence of any efficient clamps for the stomach is most noticeable. Most surgeons appear to be content to use those devised for holding intestine, a very different structure; intestine, even the large intestine, is much less bulky and can be gripped firmly with but little force; its muscular wall is not so strong, and therefore does not tend to drag itself away in the same way as do the walls of the stomach; the layers of mucosa which are opposed to one another are not so slimy and do not slide the one over the other as do the gastric surfaces; a living stomach has a peculiar elasticity and contractility which renders it specially difficult to control efficiently; there is a far greater area over which equable pressure must be exerted; the position of the organ renders it more difficult to bring into the wound and so surround with gauze; the contents of the stomach, which cannot be entirely removed previously by a stomach tube, have certain digestive qualities which will deleteriously affect any tissues which may have had their vitality lowered by the necessary manipulation, or will act upon the suture material used if allowed to come in contact with it, thereby loosening the stitches and producing possibly leakage at some later period. The area into which such escape becomes possible, either at the time of operation or later, is a peculiarly dangerous one. For all these reasons a special forceps is required; intestinal forceps are too narrow in proportion to their length and their blades are apt to slip past one another sideways when applied to the stomach. There is also a tendency for the whole organ to be compressed upwards between the tips of the blades so that a portion remains uncompressed above. Certain forceps, such for instance as Doyen's, are fashioned with elastic blades in such a way as to meet first at their extremities, but these are too slender and I have known them to snap across in the middle, when the strain becomes too great, with disastrous results. To avoid this particular drawback, Kocher devised a much stronger clamp, the tips of which are united after application by a small lever attached to one blade by a hinge; this lever contains certain openings which fit on to a small projection on the end of the opposing blade; but in practice this is awkward because the forceps can only be compressed up to certain degrees determined by the holes in the retaining bar, which are fixed, and this in securing an organ so variable in thickness as the stomach may easily prevent the exertion upon it of a sufficiently compressing force.

The clamp known as Sir T. Smith's appears to me to have all the faults which such a clamp

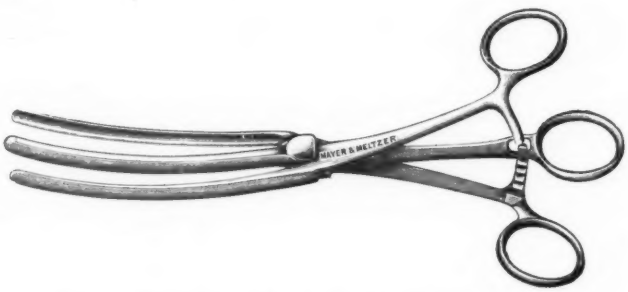


Fig. 15. E. Stanmore Bishop's clamp for gastroenterostomy.

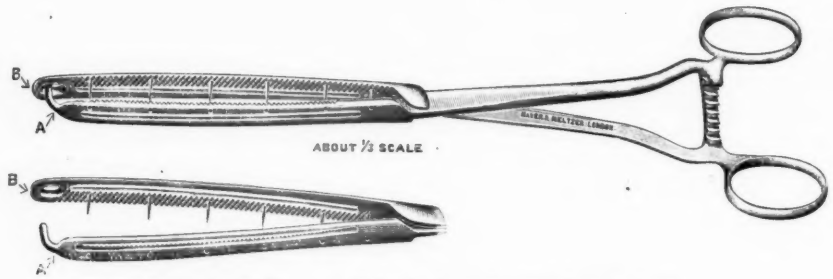


Fig. 16. E. Stanmore Bishop's clamp for partial gastrectomy.

can have, besides the obvious one of being curved; if the incision through the gastric walls is to follow this curve, much more of the wall will be excised in its center than is required; the line of union will be rendered unnecessarily long; whilst if the cut be a straight one, two mucous flaps will be left projecting and allowing their secretions to escape.

It is with the hope of meeting these various indications that the clamp figured has been constructed, and personal experience of them has shown their efficiency; these clamps are made in pairs; one with the pins on the left-hand side of the upper blade to be applied to that portion of the stomach which is to be left; the other with the pins on the right-hand side of the upper blade, to that portion which it is intended to remove; so that the pins in each forceps lie nearest to the line of incision. Each separate pair consists of two blades; the lower (A), which is passed behind the stomach, ends in a short, blunt, curved hook this hook penetrates with fair ease the gastro-hepatic omentum and can easily be felt with the forefinger of the left hand passed upwards over the anterior gastric wall; the blade (B) ends in a wide eye which fits over the hook like the process of the blade (A) and the junction of the two effectually prevents any escape upwards of the compressed tissues; at the same time it is impossible for the blades to slip sideways past one another.

Both blades are fenestrated; the portion which lies nearest to the line of incision is roughened; in this roughened bar are placed, in the blade (B) fine pins at equidistant spaces; in the blade (A) corresponding openings into which the pins fit after having transfixed the gastric walls; the minute punctures made by these pins are so small that nothing escapes by them, and as the first line of suture is made through the fenestration and therefore internal to them, they, with the united edge, are turned inwards and buried by the second line of suture.

As soon as the clamps are applied the stomach walls are divided between them fairly close to the right hand forceps (in specifying the right or left hand reference is made to the hands of the surgeon). A flat sponge is placed beneath the stomach, and the first line of sutures is applied; these should be carried through the fenestræ by long, straight, round (not cutting) needles which take up in each stitch about one cm. of both walls commencing at the lesser curvature; the suture is a continuous one; the loose thread of the first stitch is left long and is held in a clip; the final end of the suture after being securely tied is also left long; when the first line of suture is complete the forceps are removed; the long threads at each end of the suture line being allowed to pass through the fenestrum of the upper blade (B).

When the forceps are taken away these threads serve to hold up the line of union whilst the second line of sutures which unite the peritoneal surfaces over and thus bury the first row are applied; by drawing downwards slightly upon the thread belonging to the first stitch in a line with the cut edges the introduction of the first stitch of the second row is facilitated and the inversion of the united edges is favored; when the first stitch of the second row is applied and before it is knotted,

the upper long thread is cut short and this extremity of the suture line is best held straight by a pair of Allis' forceps; the second suture is carried on as a continuous Lembert suture until the greater curvature is reached, when the last thread of the first suture is drawn upwards, its knot buried by the second suture, and all cut short, the second suture having been finished off by a last knot.

This description, of course, presupposes that the duodenum is not reunited to the remnant of stomach left, but is closed and the whole procedure is followed by a gastroenterostomy; it is also presumed that the preliminary steps of the operation, as the ligature of the gastric vsssels, etc., have been carried out and that the reader is familiar with the operation as performed by modern surgeons.

During the process of suture the second pair of forceps absolutely controls the segment to be removed and prevents any escape of its contents; it may now be used to lift up this segment, drawing it forwards and to the left during the later manipulations.

These instruments have been made for me by Messrs. Meyer and Meltzer of London.

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# THE INFLUENCE OF CORSETS AND HIGH-HEELED SHOES ON THE SYMPTOMS OF PELVIC AND STATIC DISORDERS[1]

## Abstract Report of Investigations Now Being Carried on in Relation to These Factors

By EDWARD REYNOLDS, M. D.,
From the Gynecological Side — Part I

and

ROBERT W. LOVETT, M. D., Boston, Massachusetts
From the Orthopedic Side — Part II

The following paper is only an abstract report of work in progress and the authors contemplate the publication of a complete review of their results later.

THE portion of our subject which we have to present to you to-day consists of two quite separate points. First, the briefest possible resume of a purely physiological research. Second, the application of that research to certain problems in clinical gynecology.

From the purely scientific standpoint we believe our work to be possessed of interest for the following reasons. Physiological literature teems with numerous and lengthy articles and monographs devoted to the determination of the center of gravity of the living body as the starting point in the study of the mechanism of the erect posture, and while the earlier of these works indulged in much assumption of its position, the later and more scientific all conclude that the exact determination of the center of gravity in the erect posture is impossible in the living subject, and that it can be obtained only by deduction from the ascertained centers of gravity of the separated members and trunk of a cadaver, and the construction of an ideal standing figure therefrom. In the elaboration of a method which shows automatically the center of gravity of any individual erect living subject at all times and in all attitudes, we believe ourselves to have broken new ground and opened new fields for study which are of admitted importance among physiologists.

If our belief that the abdominal ptoses are frequently the result of static conditions is in any sense correct, it is evident from the standpoint of clinical gynecology that if one of the operations for the correction of a retroversion or other ptosis is undertaken in the face of general static conditions which constantly urge the uterus backward, it is pretty sure to be either an anatomical or a symptomatic failure. Again, if some inocuous uterine peculiarity is attacked

[1] Abstract read before the American Gynecological Society, April, 1909

in order to cure a backache which is dependent upon an overstrain of the sacro-iliac synchrondroses, for example, its results are not likely to be gratifying to the patient, or to add much to the reputation of the surgeon who performs it; so, too, the orthopedic surgeon, who devotes months of effort with apparatus and gymnastics for the relief of a back strain caused by the faulty posture originated by inflamed pelvic organs, is likely also to score a failure.

The orthopedic surgeons have been the first to awake to these conditions. Comparatively few gynecologists have as yet given the subject the serious attention which its frequency and importance justifies.

I regret that I am obliged, by the very limited time at our disposal, to illustrate this point by a brief outline of two typical borderland cases rather than by a properly elaborated discussion of the conditions involved, but for the spoken presentation this seems necessary.

CASE 1. Single. 53 years old. Was sent to me by a very prominent orthopedic surgeon for backache and sense of weight in the abdomen, which, in spite of evident static faults, had been uncorrected by his treatment, and which he was acute enough to believe must be traceable to some pelvic condition. On examination it was evident that her forward posture was due to an unconscious attempt to lessen pressure upon a fibroid which nearly filled the true pelvis, and that the orthopedic apparatus had been ineffective in correcting the attitude or in relieving symptoms because it had been applied in the face of the determining cause, the fibroid. The patient made a prompt convalescence from a hysterectomy, but on arising from bed was extremely discouraged to find that the backache, which had led her to seek treatment, was, if anything, worse than before, but, on returning to the gentleman who sent her to me, found that the same apparatus which had before been ineffective now gave prompt relief, and after a few months was able to drop it gradually, and is now entirely well without treatment.

CASE 2. Married. 35 years. Three major operations and prolonged local treatment, without relief, at the hands of three very prominent members of this society. Chief symptoms, renal pain and sacral backache. Operations, nephrorrhaphy, anatomical success, therapeutic failure. Two suspensions, both anatomical and therapeutic failures. Prolonged trials of pessaries by two of the gynecologists, always ineffective, always increasing pain and backache. Patient profoundly dissatisfied with the medical profession and very sceptical of obtaining any relief. Evident static faults too complicated for me to treat. I referred her to the orthopedic surgeon of her choice after she had positively declined to allow me to replace the uterus and insert a pessary on the ground of her previous experience. After considerable orthopedic treatment she was relieved of all her symptoms except sacral backache, which continued distressing. She then allowed me to insert a pessary which for the first time in her history she wore not only without pain, but with immediate relief of the backache, and after wearing it for several months became able to maitain a forward position of the uterus without the pessary. She is still under orthopedic treatment, and may of course need a pessary again, but is relieved of her symptoms and intensely grateful.* Orthopedic treatment should have preceded an operation.[1]

These are but two from a large number of such borderland cases which have come under my observation in the last few years, and which have made me confident that a knowledge of the phenomena of static backaches is of much clinical importance to the gynecologist.

At the outset of our report of our observations it is necessary to define both the conditions and the modifying influences which have been studied, namely, the symptom complex which we will call static backache, and the forms of corsets and shoes which have so far been subjected to analysis.

What we have ventured to call static backaches have not been extensively noticed in literature or so far as we know studied in any way from an accurate standpoint. By this term we mean backaches which are the product of the mechanical strains due to faulty attitudes.

These faulty attitudes may be due originally to static imperfections and may then by alteration of the intra-abdominal pressures cause ptoses, or they may be originally due to an unconscious attempt to protect abnormal abdominal organs fron undue pressure by alteration of attitude, and these faulty attitudes may then become so fixed by habit as to demand specialized treatment for the relief of symptoms even after the relief of the original abdominal cause. The faulty attitudes due to muscular relaxation are less often seen by the gynecologist.

A faulty attitude may, on the other hand, have been originally acquired by an unconscious action of the voluntary muscles in the effort to sub-Method. The subject, having been previously weighed, stands upon the balance plane shown in the illustration and the figure indicated on the dial is noted down. The distance of the more important joints from the

[1] Names of attendants omitted for obvious reasons.

measurement plane formed by the sliding arm is measured with a two-foot rule and the ventral and dorsal outlines of the trunk are taken by the instrument which the hand of the nurse is seen holding. All these are transformed to paper and form the graphic records, some of which we have to show you. Those which are here exhibited have been selected as representative types from among the records of somewhere between 150 and 200 observations which we have taken from these points. The accuracy of the method has been shown by many months' work with specially devised checking methods, including photographs. Lack of time prevents its further discussion here.[1]

We have found by many experiments that to produce any very decided effect corsets must be specially made for the individual figure. Ready-made corsets, unless extensively altered, being almost invariably neutral. The effect of any individual corset is almost wholly dependent upon the direction in which its seams run and the places at which they are tightened or loosened, but the corset bones must be so placed as not to neutralize the tensions so produced in the cloth. The spots at which the tensions must usually be increased, to increase the characteristic effect, lie between the red marks placed upon some of the seams in each form of corset. The good corset here shown is that which is most commonly found clinically to relieve static backache. The other is the most common form of those which increase it.

Before beginning our exact observations we had supposed from clinical observation that the good corset threw the shoulders back and the buttocks, if anything, forward, while the bad corset threw the shoulders and upper part of the trunk far forward, such being the effect invariably produced to the eye. Many successive graphic representations show that they really exert a quite different effect.

On account of the great importance of the fatigue curve, and of the considerable persistence of a post-corset attitude, it has been a necessary precaution that the normal should always be taken immediately before the corset observation. We have also found that it is ordinarily possible to take only two accurate observations on the same day and that they are best separated by an interval of complete rest. The points subjected to measurement are, the malleolus, the fibula, the trochanter, and the spinal processes of the fifth lumbar and seventh cervical vertebræ. In the records representing the effect of good corsets it will be observed that the center of gravity is always thrown backward, the trunk moving backward as a whole, but the buttocks, as a rule, somewhat more than the shoulders, the amount of this excess varying considerably with the type of figure of the individual model, as does also the position of the knee.

The bad corset usually moves the center of gravity backward, but it does this to a comparatively slight degree and even this comparatively small amount is effected by its throwing the buttocks excessively far back, while the shoulders are but slightly back, or, in extreme instances, even forward of the normal. The strain thus imposed upon the sacro-lumbar spine is easily appreciated. I shall leave the effect of shoes and of the combined use of corsets and shoes for Dr. Lovett, whose knowledge of them is far greater than mine.

For the experimental study it has been convenient to use professional models sent to us by one of the art schools, but it has been possible to make a partial employment of the method in some instances in our clinical work, and the last few records are selected from among a number of such cases as records of patients who were suffering from backaches, with the corsets which relieved them.

Among my records is one of a patient who was sent to me for sacral backache, due, in the opinion of her attendant, to a lacerated cervix. I believe that this backache was originally due to that cause, but upon examination it was evident that it had been produced through the mechanism of a probably secondary alteration of static attitude. I do not think that it will be permanently relieved until the cervix has been operated upon, which I shall do later, but family circumstances made it exceedingly inconvenient for her to have an operation at that time and a properly-made corset has meantime relieved her backache. It was taken about a week after the relief had been obtained.

[1] Method of Determining the position of the Center of Gravity in its Relation to Certain Bony Landmarks in the Erect Position. Am. Jr. of Physiology, May 1, 1909, Vol. XXIV, No. 2.

It is evident, from examination, that her center of gravity was moved somewhat backward by the corset, but I was unable to obtain this measurement in her case.

Another record is that of a nurse in my private hospital who was so intelligent and valuable that she was employed there for nearly a year in spite of the fact that she was seldon able to do more than a few weeks of consecutive work without an interval of rest. For obvious reasons I never inquired into the nature of her disabilities, but after she had been with us for nearly six months of her second year I noticed that she had been continuously at work all that time and asked my matron why her health was so much improved. The reply was, "Why, Dr. Reynolds, I have corsetted her, and she is no longer subject to backache." I then asked the matron, who was familiar with the instrument, to obtain at least a partial record, which will be presented later in my full report. She did not take the center of gravity, but it is quite evident that it had moved backward. In fact, in our clinical work, we have noticed that all our cases of sacral backache have carried their centres of gravity unusually far forward.

The stable types of figure are but little altered in attitude by corsets. Their centers of gravity are thrown back by high-heeled shoes, but in practice women rarely wear high-heeled shoes unless they are also wearing an effective corset, and in practice women who are wearing a bad type of corset always instinctively associate with it a high-heeled shoe. The models have always expressed themselves as more comfortable in either form of effective corset, i. e., (less uncomfortable in the bad corset) after they have also put on high-heeled shoes.

In practice what we have for the moment designated as the stable type of figures usually wear neutral corsets and state that it makes very little difference to them what forms of corsets they wear. In practice these women usually wear low-heeled shoes.

In practice the unstable types usually crave the support of corsets and are usually wearing more or less high-heeled shoes when they come into the office. These are the women who are most liable to backaches and who are most relieved by corsets. I am inclined to think that they are also the women who are most liable to ptoses.

The main characteristic of all the stable types is that their figures run upwards in a straight line above the base of support. The curves of their figures are not excessive, and any slight curve in one direction is promptly compensated by a similar reverse curve just above it. The common characteristic of all the unstable types is that they have very pronounced curves and that the outlines of their figures tend to make wide excursions to one side and the other of the base of support. In the worst types excessive curvatures in one direction are not fully compensated by the succeeding reverse curves.

The condition designated in this report as static backache has received but scant attention even from orthopedic surgeons. Many of these cases are called hysterical spine, functional spine, neurasthenic spine, relaxation of the sacro-iliac joints, weak back, lumbago, etc., and all varieties are treated, when they are treated at all, empirically by braces or corsets, belts, springs, or pads, massage, electricity, heat, gymnastics, etc. We know no more of the mechanical working of our therapeutic measures than we do of the real cause of the pain. Sometimes we cure the cases, sometimes we fail; sometimes after we have failed we send them to the gynecologist. Now all this is an unsatisfactory state of affairs to both patient and surgeon. My effort in this discussion is simply to present to you what I understand to be the state of affairs to-day from the point of view of an orthopedic surgeon, and what, in our research, we have found out of interests to gynecologists.

You are probably aware that certain cases of flat foot or weakened feet are accompanied by backache on standing and that this backache is sometimes permanently relieved by the use of a proper support to the instep. We have as yet made no observations on this point and I only mention it as perhaps the instance most likely to be familiar to you of the relief of back-strain by doing something to the base of support. An analogous instance is to be found in the backache found in those

cases of contraction of the gastrocnemius muscle, which necessarily causes faulty attitude because the patient is unable to get the foot to a right angle or get the heels squarely on the ground. In these cases relief follows in many cases the stretching of the gastrocnemius as described by Shaffer, or raising the height of the heels. These two instances, from my especial field, will indicate to you that one is not going too far astray to discuss shoes in connection with static backache. What we have found out with regard to shoes, from our research, is as follows:

1. High-heeled shoes tip the body back as a whole, with lumbar curve unchanged in most cases; in one case out of ten observed, a model tipped forward. This model had never worn corsets and her usual center of gravity was abnormally far back, which may explain the exceptional result. Otherwise the results were uniform. Apparently the higher the heel and the narrower the toe the more marked the effect. A high heel which did not reach forward nearly to the middle of the foot, as all high heels do, would apparently, from observations made early in the series, tip the model forward; such shoes are never seen.

So far as our study goes the effect of high heels in the standing position is not undesirable, so far as the body balance is concerned; there is no evidence from watching the record of the lumbar curve that they change seriously the inclination of the pelvis nor alter noticeably the curves of the back. With regard to their effect in walking we know nothing, and of course they are bad for the normal foot, but we must attribute to them no harm that they do not do.

In general our observations on patients, which are as yet very few, show in all cases of backache a center of gravity too far forward. A very striking instance was the following: A well-developed young woman, a professional teacher of gymnastics, at the end of a hard year, developed severe sacral backache. She wore a small girdle. A corset was applied which afforded immediate relief. An observation in this apparatus showed the center of gravity moved back one and one-half inches by the corsets. The observation was so striking that it was repeated a week later with similar results.

In a case of backache due to arthritis deformans of the spine, corsets gave relief but made no noticeable change in balance. Here the relief was apparently due to fixation.

I would further call your attention to a point of some interest in the persistence of attitudes assumed. To make this plain, if a bad corset is worn for ten minutes for purposes of observation, the position induced by that corset persists for some ten minutes at least. We have frequently had to abandon a second observation in models of delicate balance because they did not return to normal in the time at our disposal for observation.

Apparently high-heeled shoes modify the effect of corsets, and the models were, in all cases, more comfortable standing in shoes and corsets than in corsets alone. This was particularly noticeable with bad corsets where the effect of high-heeled shoes was most agreeable.

In considering the location of static backache I would call your attention to the following anatomical considerations. In considering what would be the probable character and location of pain in static backache the following considerations are of importance. The entire weight of the body above their level is of course transmitted to the ground through the sacro-iliac articulations. (These articulations permit but little motion, and, compared to the supporting structures above and below them, are relatively inelastic. In a given change of position in the standing attitude necessitating a change of relation throughout the body in the antero posterior plane, adjustment above this level is easy by the free motion between the vertebræ in this plane, and below this level the hips, knees, and ankles permit easy adjustment, both moving only within their normal limits.) The sacro-iliac joints, however, are not easily adjustable and will be more likely than joints above or below to show the effects of strain on account of their inability to accommodate themselves to it in their normal range of notion. The sacro-iliac joints are relatively less protected by muscular support than any joints in the body. Above them the spine forms a long lever, meeting the long lever of the legs. The leg muscles all terminate above at the pelvis, the lower spinal muscles have their origin on the iliac crest but at about the hori-

zontal level of the sacro-iliac joints. No important muscles pass over the level of the sacro-iliac joints to be inserted at enough distance above or below to contribute to them any efficient muscular support. So far as the lower two-thirds of the spine is concerned the lumbar region is the flexible part, and adjustments to disturbing causes are therefore chiefly made in this region. Static backache, therefore, on theoretical considerations, would be most evident in the lumbar regions and sacro-iliac articulations.

In conclusion we have found no evidence that a proper corset induces malposition of the normal body; on the contrary we have found that it tended to induce a more normal position when abnormal position of the type described exists. We have found evidence that high-heeled shoes work in much the same way as good corsets and tend to modify desirably the the malposition induced by bad corsets.

We have found that static backache is usually relieved by proper corsets, and this effect we attribute partly to the splinting of over-strained and irritable muscles and partly to the tipping back of the whole body. So far as our observations have gone we are inclined to believe that the most frequent cause of static backache is to be found in a center of gravity too far forward, thus inducing excessive muscular effort in the lower back to maintain equilibrium and the relief of such backache by proper corsets and occasionally by high-heeled shoes, is explained by their influence on the portion of the center of gravity.

No one can appreciate more than we do how incomplete all this must seem, but we offer it as a contribution to be accepted at its face value and as an effort to add to our knowledge of backache of mechanical origin which is bound to become constantly more frequent as the demands of our civilization on our women increase.

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# THE PREVENTION OF ADHESIONS IN ABDOMINAL SURGERY[1]

By J. CLARENCE WEBSTER, M. D., Chicago

THE ideal abdominal section should not be followed by the adhesion of structures not normally adherent. In many cases circumstances beyond the control of the operator make it impossible to achieve this ideal. Thus with a ruptured appendix or pus-tube, with infection of the peritoneum, one can only expect this post-operative complication.

While peritoneal adhesions may often be found in those whose health is very satisfactory they must be regarded as a frequent cause of pain, soreness, alimentary disturbances, neuroses, etc., and as an occasional cause of serious intestinal obstruction. It should be the aim of the operator, therefore, to make a careful study of the various factors concerned in the production of adhesions. These factors are mainly local in character and related to details of technic, though it is not unlikely that other general factors, e. g., prolonged anæsthesia, systemic weakness, anæmia, etc., may contribute to the peritoneal changes.

Experimentally, adhesions of the peritoneum of dogs may be produced by undue exposure to dry air, cold air, mechanical trauma, and cultures of micro-organisms.

In operating on the human subject, therefore, these factors should be avoided. Success is not as easy as might be imagined. It is achieved only after careful and continued practice in the minutiæ of technic. An operator may have great surgical judgment and extraordinary manipulative dexterity, and yet fail in the details of technic as exhibited by himself or his assistants.

Are the temperature and humidity of the room matters that often concern the surgeon? Yet they must be important especially when prolonged exposure of peritoneum is contemplated.

Theoretically, the most suitable atmosphere

[1] Read before the American Gynecological Society, April, 1909.

is one that is very moist and of the temperature of the peritoneum. Practically, this is never found, because operating staffs dislike to work under such conditions. An atmosphere charged with moisture at a temperature of 90° F. is perhaps the limit of endurance for prolonged surgical work.

Defects in atmospheric conditions may be to a great extent made good by the avoidance of unnecessary exposure of viscera, protecting everything save the immediate area of operation with gauze pads soaked in hot normal saline solution.

In order to reduce trauma of the peritoneum to a minimum, sponging should be employed as little as possible and all manipulations should be carried out with great gentleness. The injudicious use of retractors is likewise to be deprecated. Self-retaining instruments are better than those which are constantly being manipulated by an assistant.

In removing tissues or separating adhesions rawed areas should not be left exposed where it is possible to bury them under peritoneum.

Small areas on the parietal peritoneum, omentum, bladder, broad ligaments, mesenteries, may usually be easily covered with adjacent peritoneum by means of fine continuous catgut.

Extensive rawed areas of omentum should be removed and the stumps buried in adjacent healthy omental tissue. Adherent appendices epiploicæ should also be treated in this way.

Small rawed areas on the intestine may be buried by fine catgut sutures passed in the direction of the long axis of the bowel. Large areas cannot be treated in this way, because of the risk of contracting the lumen. Frequently omental grafts may be used to cover them. I have also used grafts from the surface of a myomatous uterus.

In tubal infections it is very common to find the ileum immediately adjacent to the cæcum adherent in the pelvis. When this is separated, the rawed surface may often be satisfactorily covered by suturing it to the movable cæcum (after removal of the appendix) in such a manner as not to constrict the lumen.

Denuded areas on the anterior surface of the pyloric end of the stomach, and first part of the duodenum, left after the removal of adhesions in the region of the gall-bladder, I have several times covered by turning up the great omentum and securing it with catgut stitches to the affected parts.

When a large area of ileum is raw and bleeding, or the wall dangerously thinned, resection should be carried out. Small tags of separated adhesions should be cauterized so as to form a black char.

Small rawed areas which cannot be covered with peritoneum or with omental grafts should be treated in this manner, because a charred surface is less likely to become adherent than a raw, oozing area; probably, because the dead char acts as a protection from the subjacent living tissue. In cases of adherent retroverted uterus I have very frequently carried out this procedure after replacement of the viscus. Experiments on animals have demonstrated that well-charred areas may heal without the formation of adhesions. A thick char cannot, unfortunately, be made on the intestine; the latter may only be lightly touched with the cautery.

Large rawed areas on the uterus, intestine, broad ligaments, or parietes I have often covered with omental grafts, stitching the latter with fine catgut.

After bilateral removal of tumors or infected tubes and ovaries where extensive separation of adhesions has to be carried out, it is impossible to prevent the descent of intestines into the pelvic cavity with consequent development of adhesions.

For eight years I have practiced the following maneuvers to avoid this complication:

1. Removal of the uterus should be carried out, its anterior peritoneal layer being left continuous with the broad ligaments. Bleeding points are secured and a strip of gauze is passed into the vagina, its upper end resting in the pelvis just above the opening in the fornix.

The broad ligaments with the intervening uterine peritoneum forming a flap across the pelvis is turned backward and stitched to the parietes and rectum so as to form a new covering on the pelvic floor.

2. When the rawed area is too extensive to be covered in this way, I stitch the utero-ligamentous flap to the upper part of the rectum

and its mesentery as it lies in a natural oblique direction across the pelvis. In this way the pelvic cavity may be entirely shut off from the general abdominal cavity and the latter may often be left without a single rawed area. This procedure is of the greatest value when the pelvis is infected or when the lower part of the rectum has been left in an injured condition so that there is doubt as to what may happen to it. Vaginal drainage may be kept up without any risk of contaminating the general peritoneal cavity. The latter may be independently drained if thought advisable. The rectum is not interfered with by this method. I have never had any trouble with it in several hundred cases.

Very rarely the rectum and peritoneal flaps cannot be used to cover the pelvis completely. In such a case a gap may be left in the right posterior half of the pelvic brim; the cæcum, if movable, may be used (after removal of the appendix) to complete the deficiency, a few stitches being used to attach it to the rectum and the parietal peritoneum. This procedure gives a very satisfactory result.

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## THE SIGNIFICANCE OF PERITONEAL ADHESIONS FOLLOWING OPERATIONS[1]

By HENRY T. BYFORD, M. D., Chicago

CLOSELY related to the protective acts of the peritoneum, such as rapid absorption, phagocytosis and the development of opsonins, is the formation of adhesions. They impede or prevent the perforation of gastric or intestinal ulcers, or direct the ulceration into an adherent loop of intestine or into a circumscribed space. Similarly they protect the general peritoneal cavity from invasion by visceral and intervisceral abscesses. They also exclude or minimize the absorption of germs and their toxins into the system. Their influence, however, is not altogether for good, since they are apt to persist after having accomplished their purpose, and interfere with visceral function. In fact it often becomes necessary to operate for their relief. Adhesions of the omentum also act harmfully in an indirect way; viz., by throwing it out of function; for an adherent and indurated omentum loses to a great extent its power of doing protective police duty elsewhere in the peritoneal cavity, which thereby becomes proportionately less resistant to disease. Hence it is important that we appreciate the significance of adhesions, and so operate that they will not form again or will not originate *de novo*. The covering of denuded surfaces with the omentum, the introduction of large gauze tampons or drains, the formation of large uncovered stumps and the attachment of viscera to each other or to the parietal surfaces, are makeshifts that are conclusive to the formation of adhesions. Although such things may be necessary at times as a choice between two evils, they belong only to imperfectly or improperly performed operations.

How common it is in these days when a brief post-graduate looking-on course in general surgery is thought to be, or pretended to be, a sufficient preparation for an unlimited indulgence in peritoneal surgery, for us to do a secondary operation for the relief of extensive adhesions due to an unskillfully performed primary operation. How many cases of ileus and other things result from such operating, the graveyards only know. Some of our own earlier records also bear humiliating testimony of imperfect performance.

Adhesions of limited extent of the intestines to denuded stumps or to imperfectly coapted incisions, causing attacks of distension of the gut and impaired digestion and even of ileus, are sufficiently common. In my records I find a case with a history of an interval operation for a contracted appendix with slight adhesions

[1] Read before the American Gynecological Society, April, 1909.

in which obstruction of the bowels supervened six months afterward. It was relieved by the separation of the cæcum from the abdominal incision to which it had adhered. A large effusion of serum into the abdominal cavity had already taken place. In fact the mere separation of adhesions about atrophic or partly destroyed uterine adnexa or the gall, bladder, have, according to my records, often been followed by the relief of symptoms and subsequent good health. And this is sometimes true in cases of non-operative as well as post-operative adhesions.

In one case of extensive pelvic and intestinal adhesions with small blood clots and thickenening and ecchymosis of the adherent omentum, following an unoperated case of extrauterine pregnancy, I removed the organized blood clots and fœtal debris but left some denuded surfaces and several catgut sutures. The patient died from other causes three weeks afterward. Upon making a post-mortem examination I found the omentum free from ecchymosis and almost normal in thickness, and no intestinal adhesions. When the original source of peritoneal adhesions has been removed, the secondary adhesions, in my experience, have not been of such firm character and wide extent as the primary ones. And this I think, is the rule in clean, carefully performed operations.

Another patient who complained for many months after the operation of persistent pain in the right lower quadrant of the abdomen, and who insisted upon another operation, was permanently cured by horseback riding upon a rather roughly gaited horse. My records show many similar cases cured by time and active exercise. It is such experience as these that has led me into a routine practice of giving laxatives early after abdominal sections with the end in view of preventing the intestinal adhesions or of breaking them up before they have become firm, or at least of limiting the extent of their formation. If mechanical means are helpful later, why should they not be early?

Adhesions of the omentum cause less immediate trouble than those of the intestines, but the omentum has not the power of loosening itself, so to speak, as have the small intestines. Such adhesions may cause trouble by interference with the functions of the viscus to which it is attached, or by its traction on the stomach. A virgin in whom I resected the ovaries by vaginal section, married subsequently and had two normal labors. At the birth of the last child, she became very nervous and complained of frequent pain in the right iliac region. Previously she had felt it mostly during menstruation. Upon opening the abdomen I found the lower end of the slightly thickened omentum adherent to an ovary which was very vascular and about four times its natural size. As the tubes showed no evidence of ever having been diseased, and as the omentum was adherent to the site of the ovarian sutures, I concluded that the adhesions had existed since the resection of the ovaries ten years before. A separation of the adherent parts relieved the symptoms. I assisted at an operation for supposed primary stenosis of the pylorus, in which the only lesion found was adhesion of the omentum about the field of an appendectomy that had been performed a few weeks before. I have not infrequently, while operating, noticed that the omentum extended down into the pelvis, not because of its great length but because the stomach was sagging downward. In such cases to draw down the omentum to protect the intestines from incisions and cover the stumps or raw surfaces in the pelvis may result in causing it to adhere there and hold the stomach down, and aid in the production of, or even produce, post-operative dilatation. It would naturally perpetuate the gastroptosis.

The prevention of these post-operative adhesions is not to be attained by any one procedure or remedial agent, but by a properly executed technic. My own preference is for small incisions with the performance of as much as practicable of the deep work by the aid of the touch, and of the remainder at the surface, and without the introduction of sponges or packs into the abdominal cavity. This kind of technic is particularly applicable to adnexal and appendiceal work during the quiescent stage of the disease. I make a small incision, introduce two fingers or the half hand, separate the adherent parts, if adhesions exist, and draw the parts to the depressed surface.

The peritoneal edges of the incision are then approximated, if necessary, and held so in the bite of a pair of hæmostatic forceps, and a piece of gauze or rubber dam adjusted around the elevated parts and over the wound. After dropping the stump or sutured part, the edges of the wound are separated, the blood sponged from the surface and a fenestrated glass tube passed down to the posterior culde-sac or pelvic walls, and the blood sucked out by means of a small rubber tube attached to a glass piston syringe. Thus the manipulation of the viscera and their exposure to air or contact with gauze is reduced to a minimum. Sometimes this kind of technic can be employed with incisions large enough to admit the hand. The peritoneal edges are sutured with fine, plain catgut that will be absorbed quickly and give rise to but little exudate. When septic conditions and deep suturing or other manipulations requiring the supervision of sight are present, it is of course necessary to make a long incision and pack the intestines out of the way. In pelvic cases after a digital exploration I place the patient in the Trendelenburg position and try and make the intestines sink out of the field of the operation and assume their own position. A firm immovable barrier of gauze can then be placed against them with almost no manipulation or relative displacement.

Thus there are two methods of procedure adapted to different classes of cases, and each possessing its own peculiar advantage with reference to the avoidance of post-operative adhesions.

With regard to drainage in laparotomies for pelvic conditions, I still have the best results, strange to say, with the old-fashioned glass fenestrated test tube. But I only leave it in place for a few hours and then supplant it by a strip of gauze that barely penetrates between the peritoneal edges. This gauze is changed about every four hours for two or three times and the opening then allowed to heal by adhesion or so-called first intention. Such slight intestinal adhesions as form are soon broken up by peristalsis. When a gauze tampon drain is required I prefer to place it low down and bring the end out through a large opening in the posterior vaginal fornix, and thus minimize the production of adhesions.

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# LOCAL ANÆSTHESIA[1]

By LEWIS L. McARTHUR, M. D.
Professor of Clinical Surgery, Rush Medical College, Chicago, Illinois

WHEN I accepted, three years ago, the invitation of our esteemed President to make a report on the present status of local anæsthesia, I failed utterly to realize the early advent of such masterly and exhaustive monographs as have since appeared. Could I have foreseen to what finality the subject had been brought by such painstaking labors as those of Professors Schleich, Reclus, Braun, and Lennander, I had not the temerity to accept this honor. You will pardon then my presentation of the work of others, which my personal investigations have only served to confirm, while deepening the conviction of its firmly established position in the Art of Surgery.

Considering the scope of this resumé as having under discussion only essential and practical factors, all references to the many interesting historical data have purposely been omitted. Understanding by the title "Local Anæsthesia," the condition induced by any of those methods of obtunding local sensibilities, singly or combined, not included in the preceding papers on General and Spinal Anæsthesia, and avoiding any controversies as to the choice of terms, e. g., analgesia or anæsthesia — let us consider briefly in the following order:

1. The physiological data in local anæsthesia.

2. The ideal local anæsthetic.

[1] Read at the International Surgical Congress, Bruxelles, Belgium, September, 1908

3. The more desirable of present known drugs.

4. Technique.

5. Its field and limitations.

It will now be generally accepted as proven that all tissues having a cerebrospinal innervation are capable of perceiving pain or may become so, while those supplied by the sympathetic alone are not (Lennander). Pain may be inhibited, when either the proximal receptive areas, the distal end organs, or the connecting nerve trunks are incapacitated to perform their function. Since inhibiting the centrally located sensory areas produces a *general* anæsthesia, there remains necessary for the production of a *local* anæsthesia either a paralysis of the sensory nerve or its end organs.

Local anæsthesia may be induced either by physical, or chemical means, and as will be later seen, is often best accomplished by an intelligent combination of several of these, appropriate for the case in question.

Physical: Pressure, Temperature, and Chemicals.

PRESSURE

Passing mention should be made of pressure. It is a matter of common knowledge that pressure on nerve trunks will render an extremity "numb," as is seen in crossing the limbs or sleeping on the arm. Acting upon this basis, many sought to induce local anæsthesia by compression of nerve trunks. Reliance was put upon the Esmarch constriction, as well as upon specially designed constrictors for making direct pressure upon the nerves themselves. From this has come the knowledge, *first*, that a much greater pressure than that employed in the ordinary application of the Esmarch band, is essential to the interruption of the nerve's function; *second*, that even though a peripheral insensibility be so secured, the centrally perceived pain through pressure on the nervi nervorum militates against its practical usefulness, as do also the late ischæmic paralyses (Volckmann) occasionally seen to follow. How pressure such as Esmarch recommended has in another way assisted materially in increasing the efficacy of chemical anæsthetics will later be shown. Pressure upon the terminal filaments from the injection into the tissues of even indifferent solutions has been shown to temporarily inhibit the local sensibilities, and is believed by eminent authorities to be a large factor in the production of all infiltration anæsthesias. Certainly the addition of an analgesic, though in extreme dilution, is essential to its practical utilization.

TEMPERATURE

That cold reduces both the sensibilities of the terminal filaments, as well as the conductivity of the nerve trunks, has long been known. If lowered to the freezing point of the tissues (.056 C.) all sensation ceases. It were here superfluous to trace the gradual evolution to its present perfection of the means of accomplishing such chilling, from the crude ice and salt mixture, up to the chlorethyl spray of to-day, but emphasis must however be laid upon one or two important facts. Nerve trunks retain their conductivity, though chilled to 5 Cent. (Grutzner); at zero lose it but regain the same on thawing. When chilling occurs suddenly, is of short duration, and not to an extremely low degree, the vitality of the tissues remains unimpaired; when gradual and prolonged, it may be followed by any of those changes observed in rigorous winter climes, from the permanent capillary paralyses to complete gangrene. Therefore, the extremely low temperatures supplied by some of the commercial freezing agents, such as chlormethyl, liquid or solid $CO_2$, etc., are used with less safety than those of higher boiling point. Worth remembering, too, is the noninflammable character of both ethyl and methyl chloride in the presence of open flames.

Induction of local anæsthesia by any of these frigorific agents, while superficially complete and permitting many very minor surgical procedures, has the drawback of being very evanescent, renders the tissues difficult of section, impossible of differentiation, while the freezing or thawing is not without discomfort to the patient.

Freezing the nerve trunks supplying given areas will induce anæsthesia of such areas, but at the cost of such suffering at the point of freezing as to be almost unbearable. It goes without saying, that wherever the circulation of the blood beneath the area to be frozen can

be controlled, the efficacy of the spray is enhanced.

Since the application of cold to a given area retards the circulation beneath that area, it will be seen that cold will prove a distinct adjuvant to the next to be considered, chemical anæsthesia. Hence the preliminary chilling of the field of infiltration aids materially in the introduction of the solution, while intensifying its effect. To take advantage of this Schleich has urged that the solution be itself chilled. While the latter is of theoretic value, practically it is not essential, and is still open to discussion.

### CHEMICAL ANÆSTHESIA

Through the action of chemical agents upon the nerve trunks, or their end organs, it is, that the highest degree of perfection in local anæsthesia has been reached.

### NERVE BLOCKING — (REGIONAL ANÆSTHESIA)

Very early in the history of cocain it was demonstrated (Corning and Oberst) that the endoneural injection of this remedy in relatively strong solution inhibited as absolutely as if it had been severed, its power of conduction, thus rendering the territory supplied thereby insensible, and laying the foundation for "nerve blocking" of to-day (regional anæsthesia).

Based upon applied anatomy it is now possibel in numerous areas of the body, to so infilfrate a given nerve trunk as to render its area of distribution sufficiently anæsthetic to permit to surgical procedures therein. While in some instances authors have recommended the exposure of that nerve trunk for the purpose of a direct endoneural injection ( 2 per cent cocain), in most instances a perineural infiltration has been demonstrated to be efficient. The mere suggestion of the superficial site of the ulnar nerve at the elbow, of the supraorbital, of the inframaxillary, will illustrate how these and many similar superficially placed nerves may be brought under the control of the surgeon for the induction of nerve blocking.

### TERMINAL ANÆSTHESIA

Terminal anæsthesia, the term applied to the paralysis of the sensory end organs through the direct action of the chemical agents upon them, has been shown to depend upon:

1. Anæmia incident to vasoconstrictors.
2. Paralysis of the sensory end organs by pressure plus chemical agent.

As a natural sequence to the discovery of the action of cocain in ophthalmology, though somewhat tardy, came the epoch-making advances of indirect (Reclus) and direct (Schleich) infiltration anæsthesia.

The general surgeon, in the earlier days following the introduction of cocain into surgery, hearing of and seeing many cases of dangerous and even fatal poisoning from the drug, became prejudiced against local anæsthesia thus induced. But the painstaking researches of innumerable investigators have at last placed the use of this and similar agents upon a safe and scientific basis.

The physiologist has shown the desirability of the solutions being made isotonic with the blood; has shown that by controlling the local capillary circulation with such an agent as adrenalin the anæsthesia can be greatly prolonged; morphia throughout almost the entire range of its physiological action, is antidotal to cocain, while intensifying its local action, hence it too has found its appropriate place in most of the accepted solutions. The formulæ for these are so well known, and the prepared tablets for the making of the same so universally to be obtained, that it is unnecessary to here quote them. They will be found appended.

### IDEAL ANÆSTHETIC

The ideal anæsthetic may be said not yet to have been discovered. When it is, it should do for the sensory apparatus, what curare does for the motor. Because of the toxicity of our best known local anæsthetic — cocain — immense efforts have been put forth by the synthetic chemist to either rob it of its toxic action while preserving its analgesic qualities, or to discover new bodies that shall be less dangerous while equally efficacious. Hence there have appeared numerous substitutes, possessing qualities that recommend them on the one hand, while having others that lessen these advantages.

The ideal anæsthetic should have a minimal toxic action, with a maximal anæsthetic effect. It should be both sterilizable and permanent. It should be soluble in water, and its solutions

should as nearly as feasible be isotonic with the tissues, approximating closely the same freezing point, specific gravity, and osmotic pressure, because under these conditions they give rise to no irritation to the tissues, and are therefore not painful. It should be neutral or feebly alkaline in reaction and combinable with adrenalin, which is not the case with some agents.

The position of cocain in local anæsthesia is forever assured, and if the present known precautions be employed need never cause dangerous toxic symptoms. Since the introduction of the dilute solutions of Schleich or Braun these have disappeared from the current literature.

Of the constantly lengthening list of local anæsthetic agents we are in a position to speak positively of two, one representing the best of the derivatives of the Benzol ring, the other the best of the synthetic bodies not containing the benzol molecule.

### ANÆSTHETIC AGENTS

Novocain (the hydrochlorate of ethyl ester of paramidobenzol), (discovered by Einhorn) in the opinion of the majority of authorities should head this list. It occurs in a fine white powder — very soluble in water, in which it can be boiled without decomposition. Its solution is neutral. Its qualifications are that it induces a perfect local anæsthesia of shorter duration than that of cocain. Even in strong solutions or the solid state it is unirritating to the tissues, constant in action, and is five to seven times less toxic than cocain. Its lethal dose for rabbits 0.350, for dogs, 0.250 — per kilo. It is a vasoconstrictor. It does not produce the shock, cardiac, or respiratory failure formerly seen. As yet it is the safest of the known agents. 0.075 gm. can be used without danger in an adult, 0.500 gm. having been given without fatality. The skin has been observed to remain anæsthetic to the needle four hours after infiltration with one-half per cent isotonic novocain suprarenal solution. It is combinable with suprarenin. No cases are recorded of a destructive action on the tissues. Dubot (Bruxelles) favors its action on the urinary mucosa in one per cent to two per cent solution. It can be put up in prescriptions with few incompatibilities — sodium borate, potassium iodide, Fowler's solution, cacodylate of sodium. Its action upon the motor nerves is less than either that of cocain or stovain (Heincke).

Stovain (the hydrochlorate of amyleine amylene) first brought to notice by Fourreau, given most extensive trial and warmly espoused by Reclus, is a brilliant, flaky powder resembling cocain. It is extremely soluble in water, in which it may be boiled without decomposition or loss of anæsthetic properties. It is mildly antiseptic. It can withstand 115° C. without decomposing and does not yield the benzol ring. In the opinion of Ehrlich and others the benzol ring had been deemed essential to the existence of a good local anæsthetic. Being a derivative of amyl alcohol many of its physiological actions resemble those of the mother substance. Most authorities ascribe to stovain a vasodilator action. In toxic doses it produces paralysis of hind legs, tonic followed by violent clonic spasms, coma, and death. It slows the pulse, contracts the pupils, causes flushing; no dyspnea nor syncope, no uneasiness nor excitement. Compared with cocain it is much less toxic. Marked changes in all the organs are to be observed post-mortem, with dilatation of peripheral and deep vessels. Taken internally 1 to 3 centigrams have been followed by slight malaise. It abolishes the vital properties of cells and acts as a poison to the central nervous system. It has one-third the toxicity of cocain as shown by the following table:

THE RELATIVE TOXIC ACTION OF THE THREE DRUGS — HYPODERMICALLY

| per kilo | cocain | stovain | novocain |
|---|---|---|---|
| Rabbit | 0.05- 0.1 | 0.15- 0.17 | 0.35- 0.4 |
| Dog | 0.05- 0.07 | 0.15 | 0.25 |

(H. Braun.)

Its tonic action on the heart, its flushing of the cerebral vessels, its antiseptic properties, its analgesic powers, its cheapness are in its favor. Offsetting these however are the facts that it exerts, except in very dilute solutions, an injurious influence on the tissues, causing at times even a local gangrene of the same, especially in conjunction with adrenalin (Sin-

clair); it is slightly acid in reaction; its field is not blanched as by cocain, the wheal is less visible, and some discomfort is noted by the patient.

### TECHNIQUE

Indifference to rather than ignorance of the essentials of a proper technique, have done more to discredit and retard the general introduction of local anæsthesia than all other factors combined. It cannot be too strongly urged upon those contemplating its usage, the following out of those simple procedures which have now crystallized into a system that leaves but little to be desired. They are to be found in the text-books fully and concisely presented. I hope I may be pardoned if I delay but a moment to hint at one or two. It is an error to suppose that satisfactory work can be done with inappropriate instruments, and yet the large majority of those who have experimented with local anæsthesia have done so with their ordinary hypodermic syringes and needles, using extemporaneous watery solutions of varying strengths, while disregarding entirely the results of the enlightening researches which have shown how absolutely important their scientific compounding is. While it is true that much good work can be done with such improvisations, if one contemplate seriously employing this form of anæsthesia he should provide himself with the accepted armentaria, and follow proven methods. It were here both superfluous and an impertinence to go into the minute details of the technique, but one may be permitted to summarize its essentials as follows:

1. Stasis of circulation when possible.
2. Cooling of area.
3. Endermic as well as hypodermic infiltration of the skin to be incised.
4. Choice of the more dilute solutions for extensive areas.
5. Paralyzing the sensory nerve trunks of the given areas by endo- or perineural injection when possible.

There exists scarcely an operation in major or minor surgery that has not been performed under local anæsthesia. Nevertheless it has decided limitations; as well as emphatic indications. Enthusiasm should neither extend, nor indifference restrict, too greatly, the field to which it is entitled.

### LIMITATIONS

There will always be a group of patients, coming to the surgeon, pyschically so constituted that no interference will be tolerated while conscious. Again there are certain areas in which a satisfactory local anæsthesia cannot easily be secured, or if secured, the length of the desired operation may outlast the anæsthesia. On the other hand, innumerable minor surgical operations, for which the surgeon in the recent past gave and even at present, gives a general anæsthetic, could be spared this distress, and danger, by the use of the method under consideration. Urgent indication for its use to the exclusion of a general anæsthesia should be seen and heeded in the aged, the atheromatous, the bronchitic, the nephritic, and those with cardiac lesions.

In our larger hospitals with their numerous able anæsthetists, it is so easy to have brought to the operating room in rapid sequence our patients, anæsthetized and ready for immediate operation, that the tendency still exists to conserve the operator's time and comfort rather than the patient's best interests. For many of these could more safely and with less distress to the patient have had the same done by local anæsthesia (Peccavi). Finally, a by no means insignificant number of patients will permit operative interference under local anæsthesia, who refuse absolutely a general narcosis.

In conclusion, I wish to urge upon the surgical profession the giving to local anæsthesia as now perfected, that earnest and fair trial which the successes of the noted leaders in this field have shown may be theirs likewise if they but will.

### APPENDIX

*H. Braun's Standard Solutions.*

SOLUTION I.

| | |
|---|---|
| Novocain | 0.25 |
| Phys. salt sol | 100.0 |
| Suprarenin sol (1:1000) | 5 drops. |

SOLUTION II.

| | |
|---|---|
| Novocain | 0.25 |
| Salt sol | 50.00 |
| Suprarenin (1:1000) | 5 drops. |

SOLUTION III.

| | |
|---|---|
| Novocain | 0.1 |
| Salt sol. | 10.0 |
| Suprarenin | (1: 1000) 10 drops. |

SOLUTION IV.

| | |
|---|---|
| Novocain | 0.1 |
| Phys. salt sol. | 5.0 |
| Suprarenin | (1 :1000) 10 drops. |

Used same as cocain solutions 1 to 4.

*Schleich's Solutions.*

SOLUTION I.

| | |
|---|---|
| Cocain Mur. | 0.2 |
| Natri. Chlorati | 0.2 |
| Morphini Muriat. | 0.02 |
| Aq. Destil. | 100.00 |

SOLUTION II.

| | |
|---|---|
| Cocain Mur. | 0.1 |
| Natri. Cholorati | 0.2 |
| Morphini Mur. | 0.02 |
| Aq. Destil. | 100.00 |

SOLUTION III.

| | |
|---|---|
| Cocain Mur. | 0.01 |
| Natri. Chlorati | 0.2 |
| Morphini Mur. | 0.005 |
| Aq. Destil. | 100.00 |

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# THE RADICAL TREATMENT OF DEFORMITY FOLLOWING AN OLD FRACTURE OF THE LOWER EPIPHYSIS OF THE TIBIA

BY HENRY O. FEISS, M. D., CLEVELAND, OHIO

IN the issue of October 8, 1908, of the Boston Medical and Surgical Journal, Dr. Coolidge of Pittsfield reports his own case of old fracture of the epiphysis of the tibia. This paper stimulated me to report a similar case, and more especially because Dr. Coolidge had nothing to say about the radical treatment. Previous to publishing this, I have looked up the literature on the treatment and found nothing with special reference to operative interference except the general instructions for correction of bone deformity after old fractures. The subject ought to be of special interest because the result obtained in this case has been so satisfactory.

Following is the history of the case:

M. S. B., age 33, first appeared at my office March 11, 1907. When a lad, perhaps ten years of age (1884), he had sustained a so-called Pott's fracture. After reduction he got along fairly well, but deformity was soon noted. In 1895, i. e., eleven years after the

Fig. 1. Sketch of foot in a position of function.

Fig. 2. Same foot in a position of pure deformation. Note line of tibial deformity about the same as in Fig. 1, the difference being simply that compensation for function is obliterated.

accident, the deformity was so severe that he saw a local surgeon, who prescribed a certain kind of shoe. Getting still worse, he saw another surgeon, who suggested orthopedic treatment. He went to New York and saw a man of excellent reputation, who made a brace for him. At the time I saw him he was still using a brace under the direction of the New York man. In spite of this the deformity was getting worse and the patient felt that the outer bone was getting lower than ever. He suffered from marked disability and pain and was able to walk only very moderate distances.

My examination showed the right foot (Fig. 1 and cast on left in Fig. 8) distinctly deformed in the lateral plane, the whole foot being thrown inward. The vertical distance between the internal malleolus and the external malleolus was increased fully one inch above the normal, and the fibula seemed to have grown well down toward the floor. The motion in the astragulo-tibial joint was excellent. Shortening, measured from the anterior superior spine to the internal malleolus was 2¼ inches, as compared with the other leg. The character of this deformity was explained by the Roentgen findings (Fig. 3). They showed that the tibia was bent inward and that the line of the astragulo-tibial joint was very oblique, forming an angle of forty degrees with the horizontal. The fibula showed a more marked deformity than the tibia being bent farther inward, and its lower end extending fully 1½ inches below the tibio-astragular joint. The astragulus was markedly tipped as implied in the change in the direction of the joint. The patient walked very lame.

It is noteworthy how closely my case resembled that of Dr. Coolidge's. The change in the shape of the bones was almost identical. The astragulus was tipped in the same manner and the external contours were almost alike. The chief difference seemed to be in the subjective symptoms. Dr. Coolidge states that in his own case "but little difficulty had been experienced." In the case of my patient the condition was the reverse; the difficulty experienced was extremely severe, so severe, indeed, that he was in a constant state of discouragement and mental anguish.

It was plain that such a foot if disabling was worse than useless, and after carefully examining the patient again and considering the extreme disability which he was suffering, I came to the conclusion that only operative interference could offer him any hope.

In contemplating an operation, there were two important factors to be considered. The first was the line of weight-bearing. With the foot in such a state as he presented it, most of

Fig. 3. Roentgen picture taken just before the operation.

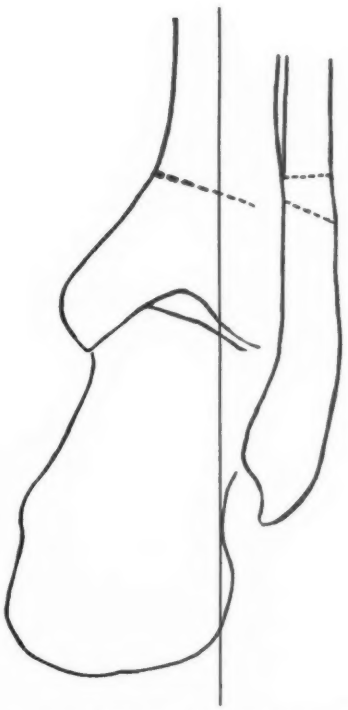


Fig. 4. Plan of operation based on the outlines of the bones in the Roentgen picture (Fig. 3), in relation to an approximately central vertical line of weight-bearing. Dotted line in the tibia represents the direction and extent of the osteotomy and those in the fibula the shape of the bone resected.

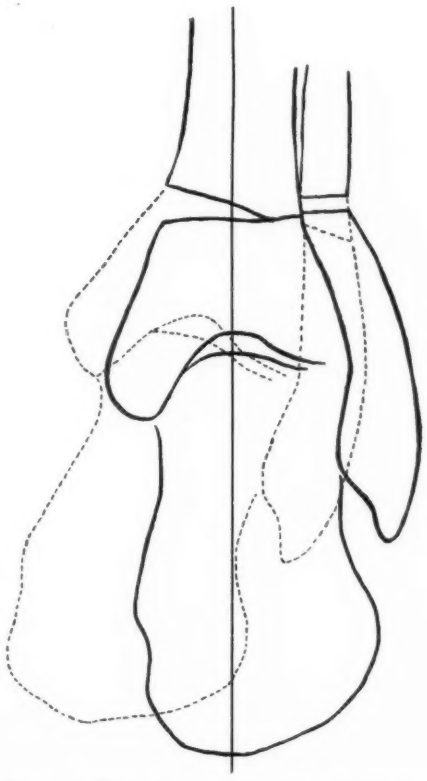


Fig. 5. Outline of bones after operation carried out according to plan. The remainder of tibia broken. Lower fragments adjusted so that the line of weight-bearing passes somewhere near the center of the heel. The gap in the fibula left purposely so that the interposition of new callus could not push apart the fragments, and destroy the relation of the tibial fragments. Dotted line represents the original shape before the operation.

the weight was being conveyed from the tibia into the heel in an oblique direction. The lateral ligaments and muscles were therefore under very great strain on account of the tendency of the tibia to ride downward and outward. He was really walking on the external ligaments of his ankle. It was then clear that an important indication for remedy was to permit weight-bearing to pass from the tibia through the astragulus and os calcis in a vertical direction.

The second factor to be considered was the fact that there were really two deformities, one above the ankle and the other below the ankle (see Fig. 1). In an earlier paper (Mechanics of Lateral Curvature, fourth paper, American Journal of Orthopedic Surgery, 1908), it was suggested that a clear comprehension of any joint malformation could be gained by subtracting from the total deformity all such deformity as was due to compensation. To do this we had to place the part in a position of so-called "pure deformation." We used the present example to illustrate this point showing that if this foot were bent in a certain direction all deformity could be obliterated except the true deformity in the bones themselves (compare Figs. 1 and 2). In other words, it was found that the apparently complicated disfigurement in this case was only partly due to real deformation in the bones and that the rest was simply due to the position of the foot as

Fig. 6. Roentgen picture taken shortly after the operation.

Fig. 7. Roentgen picture taken about twenty months after operation, showing complete union of the bones with the fragments in the exact position outlined in the plan shown in Fig. 5.

necessitated by the patient's endeavor to keep the sole of the foot flat upon the ground in walking and standing. So of the two deformities mentioned, the one above the ankle and the other below the ankle, the former only was due to real deformation and the latter to compensation for the sake of function. Therefore it seemed certain that if we remedied that deformity above the ankle the lower deformity would take care of itself as no further compensation would be required.

With these points in mind the following operation was planned (Figs. 4 and 5): Removal of a piece of bone from the fibula and an osteotomy of the tibia, the osteotomy of the tibia permitting a correction of the tibial deformity and the gap in the fibula enabling this correction to be made. The case was seen in consultation with Dr. Robert Lovet and the operation as planned above was decided upon.

On May 13, 1907, at Lakeside Hospital, the operation was carried out by the author according to the plan. An incision was made over the internal surface of the tibia one inch above the ankle joint. An osteotomy was done through three fourths of the transverse section of the bone. Then an incision was made over the fibula opposite the osteotomy. A part of the shaft of the fibula was resected with a gigli saw as according to plan. (Realizing that if the divided ends of the fibula were too closely approximated the new callus growing out might disturb the position of both legbones, it was deemed best to leave a gap for the callus to grow into. This would delay union in the fibula until the tibia had made good progress toward firm union.) This having been done, the remainder of the tibia was broken. Correction was now made and the foot was put up in plaster in a position of

equinus and slight varus. The equinus was left purposely and not corrected because experience has shown that where there is shortening a little equinus sufficient to compensate for the shortening makes it easier to wear a high shoe.

The convalescence was uneventful except that the day after the operation the toes were swollen and the patient suffered considerably. This was remedied by splitting the plaster. The patient did well and May 22 the plaster was removed in order to have a Roentgen picture taken (Fig. 6), the object of which was to determine definitely that the position of the fragments was proper. The Roentgen picture showed that the result aimed at was being achieved. The chief point studied was the imaginary line drawn from the center of the tibia through the center of the heel. It was plain that this would now be about vertical. The external conformation of the ankle had greatly improved and although the tibio-astragular joint was still quite oblique it was decided not to make any other correction but to be content with sufficient correction to allow proper weight-bearing. The patient continued doing nicely, and June 5th he was allowed to walk with crutches. On June 22d light massage was begun. On July 17th a brace was applied with an inner upright and a strap holding the ankle to the upright. No stop was placed at the ankle joint. Measurements on July 20th showed that the shortening of the leg was $1\frac{5}{8}$ inches, indicating that he had gained $\frac{5}{8}$ of an inch in the length of the leg. On August 8th another Roentgen picture was taken showing new bone forming nicely. On September 19th a shoe was made to order with directions to take care of the shortening by simply raising the heel and carrying this raise well forward under the arch. On October 11th the patient was wearing his new shoes without the brace. He was, however, still limping. On November 17th the patient reported progress, but had some pain in the medio-tarsal joints. He was told to wear his brace occasionally. On December 3d the patient was walking quite well but still limping a little. From this time on the patient made steady improvement and he has been under observation up to the present time. He was last seen January, 1909. He was walking without a limp and used no cane.

Fig. 8. Casts of foot before and after the operation.

He wore no apparatus. The only precaution he has to take is to have his shoe raised in the heel as already described. He can walk miles, and one day last summer played fifty-four holes of golf.

A Roentgen picture taken this January (Fig. 7) showed the condition practically the same as the picture taken after the operation with the simple difference that the gaps in the bones have filled up with new bone. It is plain that the line of weight-bearing is properly directed. A comparison of the present shape of his foot with that before the operation can be seen in the cuts of the casts (Fig. 8), and if it were not for the extra lengthening in the fibula and the shortening of the leg, no one would notice that the patient had ever had a deformed foot.

# SYMPSOIUM UPON SURGERY OF THE THYROID GLAND

## THE PATHOLOGICAL RELATIONSHIPS OF EXOPHTHALMIC AND SIMPLE GOITER[1]

By LOUIS B. WILSON, M. D., Rochester, Minnesota
Director of Laboratories and Pathologist, St. Mary's Hospital

Fig. 1.

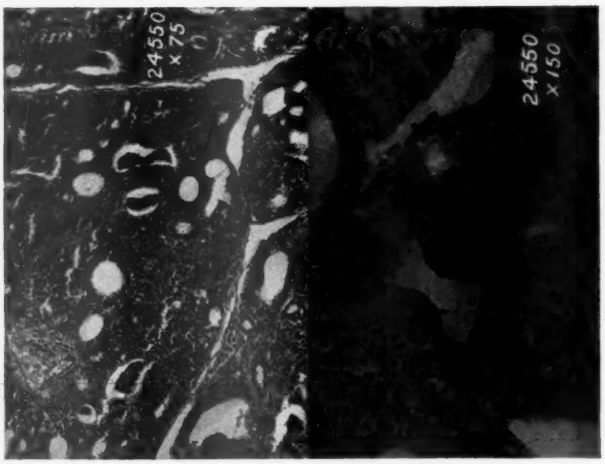



Fig. 2.

IN a previous communication[2] I have attempted to show that certain pathological changes in the thyroid gland have a definite relationship to the varying symptoms in Graves' disease. That such a definite relationship does exist there can be no doubt in the mind of anyone who has examined any considerable number of cases, comparing the lesions with the symptoms. Such an examination invariably shows that all early acute cases of Graves' disease of whatsoever degree of severity show unmistakable evidence of increased secretion by the gland and of increased absorption from it. It matters not in what form the increase of functionating parenchyma occurs, so long as there is such an increase associated with unblocked lymphatics the train of symptoms best designated hyperthyroidism is present. More than this,

Fig. 3.

[2] Wilson. Transactions Association American Physicians, 1908, XXIII, pp. 562–578. American Journal Medical Sciences, December, 1908.

[1] Read before the Pittsburg Academy of Medicine, Feb. 9, 1909. For discussion upon this symposium, see p. 655.

Fig. 4.

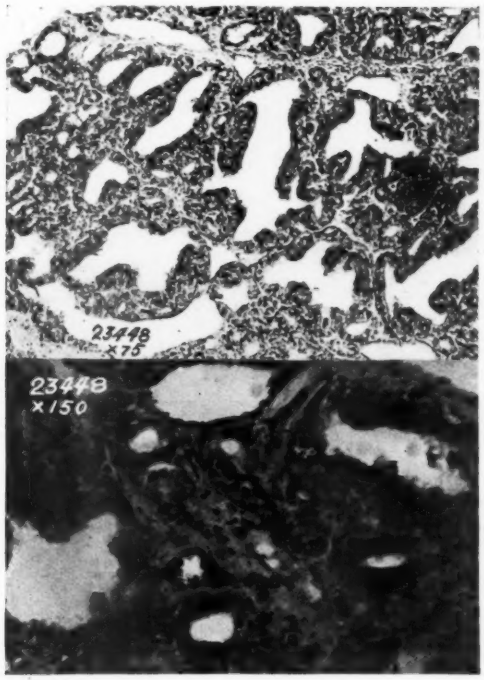



Fig. 5.

the relative amount of increase of working tissue and absorbable secretion is almost invariably markedly paralleled by the degree of severity of the symptoms. Later in the history of any case of exophthalmic goiter, when for any reason the parenchyma cells are decreased in function, either from overwork, pressure or insufficient blood supply, or when lymphatic drainage is blocked either from increased connective tissue, the result of reaction to endogenous irritants, or from medical or surgical interference, it will be found that the symptoms of thyroid toxemia begin to remit. Finally, when glands removed in cases of previous hyperthyroidism are found to consist of acini lined with flattened or desquamating epithelium and filled with a thick gelatinous non-absorbable colloid a careful study of the symptoms of the case will show that the patient is suffering from lesions of vital organs — heart, central nervous system, etc., which were produced by a long-passed thyroid toxemia. It has been the not unusual finding of such lesions at the autopsy table in cases dead after a long history of Graves' disease, which has served greatly to mystify our conception

Fig. 6.

Fig. 7.

of the essential morbid histology. It is only by a study of such cases, sufficiently large to give a broad picture of the pathology, that one is able to trace its development.

In considering the relationships of the pathology of exophthalmic and simple goiter, we are

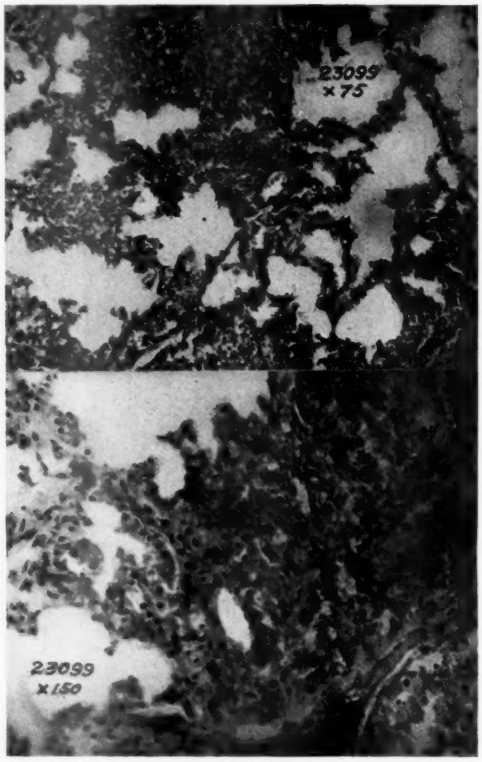



Fig. 8.

Fig. 9.

apt to be blinded by our old teachings that the two are always distinct entities. Though this has been disproven clinically over and over again, we find every once in a while some one writing learnedly of either the diagnosis or the pathology of the two diseases, as though they never in the same individual changed from one to the other.

As a matter of fact, close inquiry will, in a very large percentage of cases of simple goiter, reveal symptoms which are unmistakably those of exophthalmic goiter, and conversely, *if the patient lives long enough*, every case of exophthalmic goiter is hypothetically destined, in the order of pathologic degeneration, to become a case of simple goiter. In examining cases of so-called simple goiter for exophthalmic symptoms, we must get completely away from our old teachings that

Fig. 10.

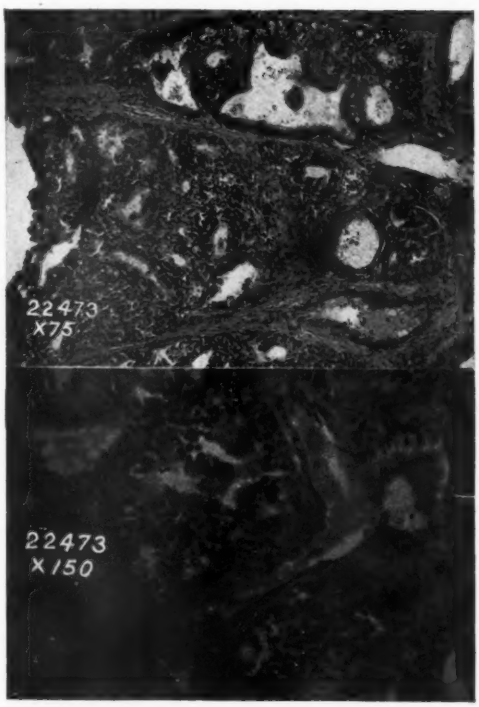



Fig. 11.

exophthalmos is a *sine qua non* of Graves' disease. The disturbed nervous, metabolic and muscular phenomena are quite essentially diagnostic. Looked at fron the clinical standpoint then, a case of Graves' disease is one with an enlarged thyroid and exhibiting symptoms of too much absorbed thyroid secretion, while a case of simple goiter is one with an enlarged thyroid, but exhibiting no such symptoms.

The examination of about six hundred thyroids removed at operation by Dr. C. H. Mayo from cases of so-called simple goiter, has shown us that they are all alike in one respect, viz.: that they consist of swollen acini, whose walls are either stripped of their parenchyma or lined with thin, flattened, feebly staining epithelium, and whose contents are apparently non-absorbable; in other words, that the gland is doing a decreased amount of work, and that the tissues are not absorbing the result of its previous activity.

In arriving at a conception of the actual pathological condition in any goiter case, it is necessary to consider the gland as a whole and not any circumscribed portion of it. Failure to recognize this rule has led in the past to the numerous loose and unsatisfactory classifications with which literature is burdened. We must remember that the absorption of a certain amount of thyroid secretion is necessary to the maintenance of metabolic equilibrium. Hal-

Fig. 12.

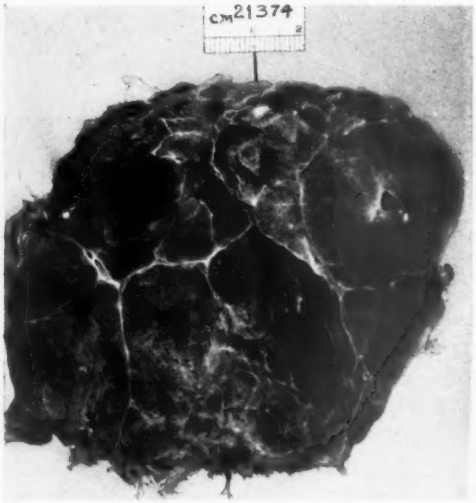



Fig. 13.

Fig. 14.

Fig. 15.

sted[1] has shown that the excision of a portion of the thyroid in dogs results in a compensatory hypertrophy of the remainder of the gland. Similarly, when nature cuts off the absorption of secretion from a portion of the gland, there not infrequently results a compensatory hypertrophy of some other portion. Usually this compensation is accomplished by the multiplication of new acini resulting in the histological picture of adenoma. Occasionally, though rarely, the parenchyma of existing acini may proliferate by reduplication of its layers, infolding of the acinal walls or papillary projections into the acini. When this process is merely sufficient for compensation no symptoms of exophthalmic goiter arise; but in simple goiter, where the proliferation proceeds to overcompensation, i. e., where the increased working tissue is discharging a relatively increased amount of secretion into the lymphatics, we have symptoms of Graves' disease supervening on those of simple goiter. The condition of compensatory hypertrophy is apparently that which Kocher[2] designates *hypertrophic follicular goiter, struma parenchymatosa* and *struma adenomatosa recurrens*, though our observations do not bear out his statement that the former is really nothing but a primary stage of diffused colloid goiter. It is true that it is occasionally seen in early

[1] Halsted. Johns Hopkins Hospital Reports, 1896, i, p. 373.
[2] Kocher A. Keen's Surgery, 1909, iii, pp. 336–398.

Fig. 16.

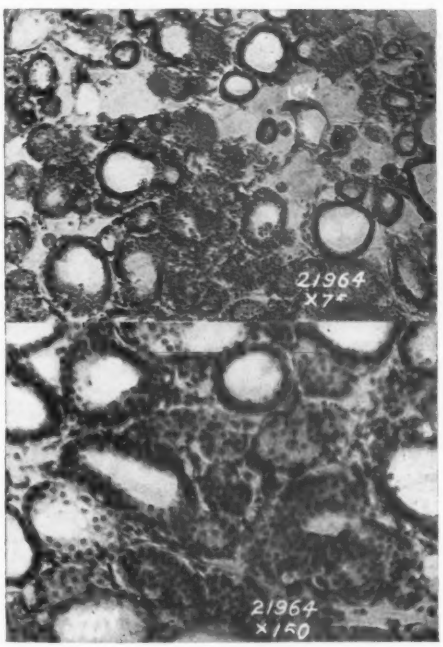



Fig. 17.

Fig. 18.

cases of simple goiter, but it is also true that it, like ademomatous proliferation is much more frequently found in advanced cases of simple goiter in which the bulk of the gland is so blocked that insufficient secretion is being given up to the organism to maintain normal metabolism.

From the pathological standpoint we would prefer to recognize only two principal types of simple goiter, viz.: the diffuse or parenchymatous and the nodular or encapsulated; regarding focal parenchyma increase as a compensatory incident in the history of either type. It would seem probably correct also to so regard hypervascularization. Areas of hæmorrhage, fibrous changes and lime salt deposits must, of course, be considered as degenerative changes. Either type may become cystic or cancerous.

In order to make more clear the relationships of the different types of thyroid enlargement, I wish to present for your consideration portraits, photomicographs and brief protocols of several cases; first, a few of Graves' disease.

CASE 24550. Group 1, Fig. 1. This specimen is a gland which is hard and nodular, the cut surface is particularly dry and granular throughout. There is

Fig. 19.

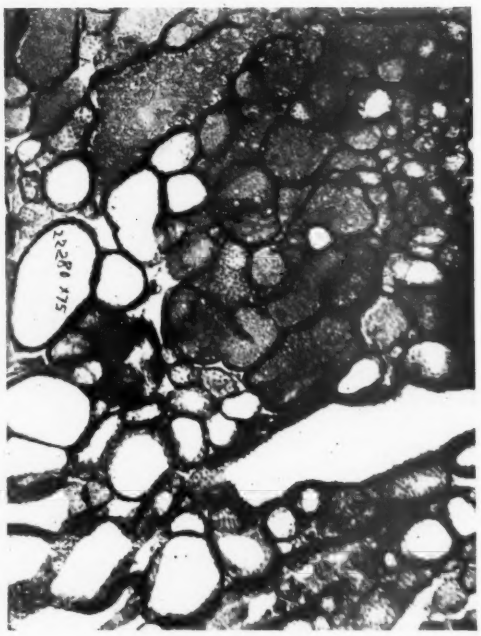


Fig. 20.

Fig. 21.

considerable increased vascularity, the veins being swollen and thin-walled. Microscopically (Fig. 2) the stroma bands are thickened and extensively infiltrated with leucocytes. The alveoli are from 0.06 to 0.2 mm. in diameter. There are very few papillary projections into the alveoli. The parenchyma walls are increased in number in certain alveoli, both in the single layers and by reduplication of the layers. The cells are columnar, about ten microns in diameter, have swollen nuclei, granular cytoplasm and show in many areas mitotic figures. There is apparently no exfoliation of the parenchyma cells; the secretion is small in amount, thin and readily absorbable. The clinical history shows a female. (Fig. 3) 20 years of age, who has had a slight symptomless enlargement of the thyroid for one year and moderate Graves' symptoms for the last two months, i. e., tachycardia, fine tremor, sweating, etc.

This case represents about the earliest type of Graves' disease operated upon. Had the case been operated on before the development of Graves' symptoms it might have been mistaken for a case of simple goiter with parenchymatous hypertrophy such as is shown in the histological picture and with no blocking of the lymphatics. It would seem more reason-

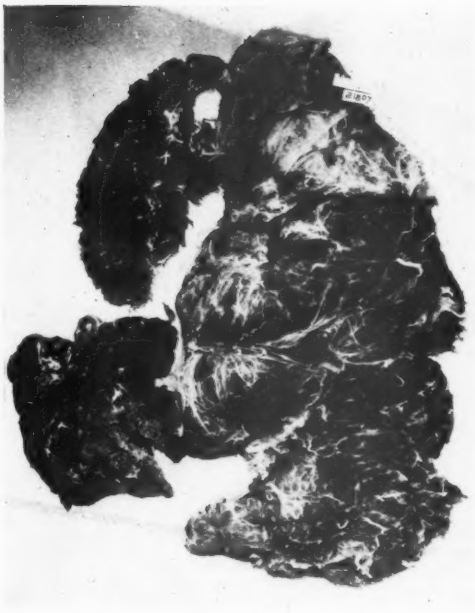


Fig. 22.

Fig. 24.

Fig. 23.

ble, however, in view of the history of the case, to regard is as one in which the parenchymatous hypertrophy and overwork of the gland was being compensated for some months before the absorption became so great as to render compensation no longer possible, with the consequent development of Graves' symptoms. It does not seem that such cases should be considered as simple diffuse goiter.

CASE 23448. Group II. Fig. 4. Shows you a photograph of a gland of the same character grossly as the preceding. Histologically, however (Fig. 5), there is a large amount of intra-alveolar parenchyma, increased papillæ formation, and a large amount of thin secretion. Clinically (Fig. 6), the patient is a woman 28 years of age with a history of two years of Graves' disease, and at present severe symptoms, viz.: tachycardia, nervousness, tremor, profuse sweating, some diarrhœa and vomiting and exophthalmos.

CASE 23099. Group III. Fig. 7. This is a 120 gram gland, hard, nodular with a granular, glairy cut surface and swollen tortuous veins. Histologically (Fig. 8), there are large alveoli with great intra-alveolar parenchyma increase, increased papillæ formation and a large amount of thin, non-staining secretion. As can be seen in both the 75 and the 150 diameter magnifications there is beginning cytolysis. Clinically (Fig. 9), the patient is a female, 36 years of age, who

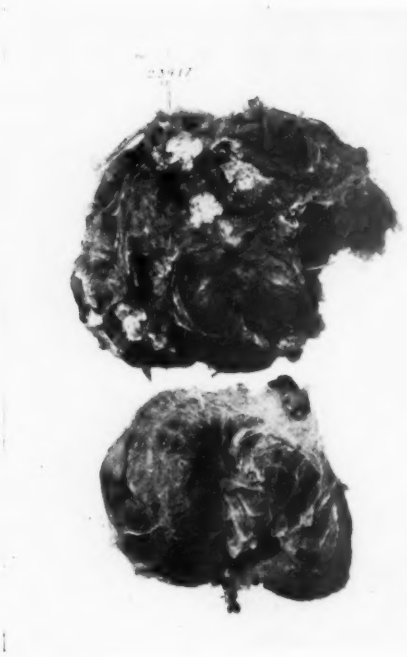


Fig. 25.

Fig. 26.

has had progressive symptoms of Graves' disease for three years. The symptoms are now of very severe type, i. e., tremor, palpitation, tachycardia, diarrhœa and vomiting with pronounced exophthalmos for one and one-half years.

These two cases illustrate very well the usual pathological findings in the severe non-remittent types of Graves' disease. They represent much the largest group of our cases. The incident of marked cytolysis in cases of this kind is invariably associated with symptoms of unusually severe type, it having been found present in all our cases that have died, either with or without operation, with severe symptoms of thyrotoxicosis.

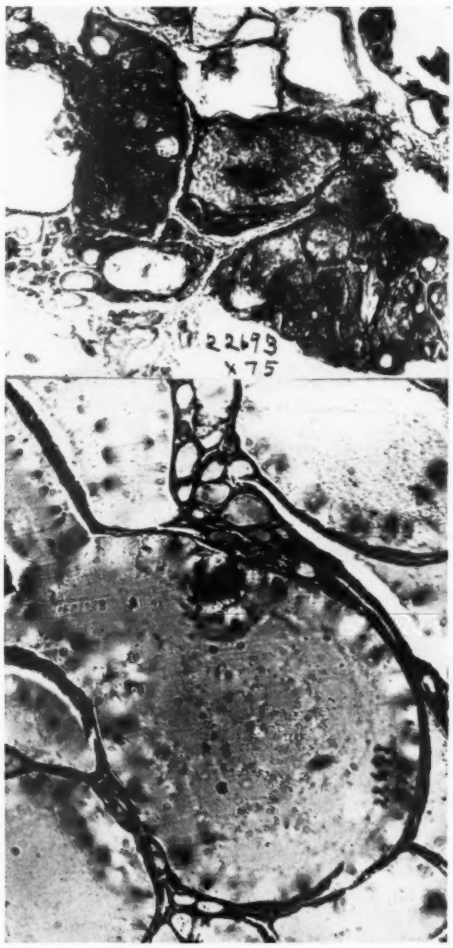
CASE 22473. Group IV. Fig. 10. This is a 35 gram gland, whose granular, glairy cut surface presents some alternating areas of gelatinous appearance. Histologically (Fig. 11), the large alveoli contain numerous papillary projections but the columnar parenchyma cells are exfoliated in-many areas. There is a large amount of secretion, much of which is thin and non-staining, but some of which is thickened and stainable. Clinically (Fig. 12), the patient is a woman 29 years of age, who for three years has shown symptoms of Graves' disease, which although now of severe

Fig. 27.

Fig. 28.

type are nevertheless less severe than they have been previously.

Fig. 30.




Figs. 29 A and 29 B.

This case represents our third group of exophthalmic goiter. They are those cases which pathologically show an early degeneration of the parenchyma and clinically, more or less remission of symptoms.

CASE 21374. Group V. Fig. 13. This is a 200 gram gland, hard and nodular externally with a gelatinous cut surface. There is no markedly increased vascularity, while the stroma has materially increased. Histologically (Fig. 14), the alveoli are quite large (0.6 to 1 mm). There is almost complete exfoliation of the parenchyma cells, but the original character of the gland is distinctly shown by well-preserved remains

Fig. 32.

of papillæ in some of the alveoli, as will be seen in the 75 diameter magnification.

Fig. 34.

Fig. 33.

This case is a woman (Fig. 15), one of the fourth group of our series, which pathologically show marked degeneration and a previously greatly increased functionating parenchyma, and clinically show marked total improvement, though some of the cases may still be suffering from symptoms due to the lesions, long precedingly acquired, of the vital organs.

CASE 21964. Group VI. Fig. 16. This is an 88 gram gland, hard and nodular externally, and showing small cysts on its cut surface, which is otherwise dry and rather solid looking. Histologically (Fig. 17), the alveoli are found to be small, many of them of the fœtal type. They are very numerous and proliferating. There is only a small amount of a thin, non-stainable secretion. Clinically (Fig. 18), the patient is a female 33 years of age, who has had a slowly developing gland for six years with Graves' symptoms coming on so slowly that they caused no disturbance until two years ago, and even now they are only moderately severe.

This case represents our fifth group. In the present instance there seems little doubt that the case is one of a proliferating adenoma from the beginning, since throughout the gland there is no evidence of accumulation of

Fig. 35.

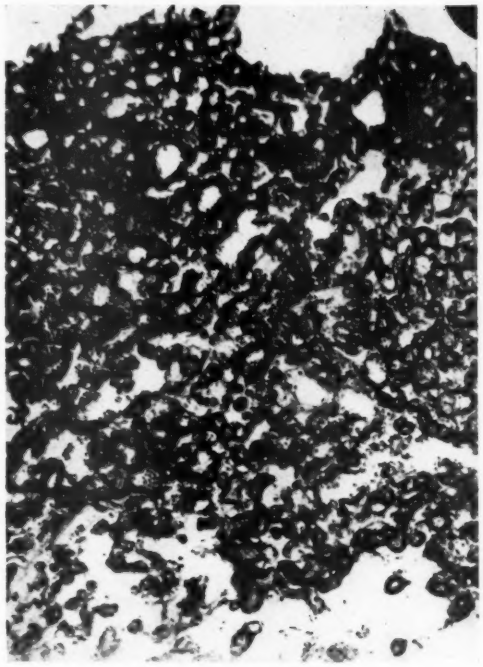


Fig. 36.

markedly thickened colloid, and since the symptoms, though mild at all times, nevertheless presented a continuous development.

Exophthalmic goiters of this adenomatous type present the same stages of proliferation and degeneration as do those of the intra-alveolar series. It is sometimes extremely difficult to distinguish these cases pathologically from cases in which the symptoms of hyperthyroidism have developed after a long history of simple goiter. However, speaking broadly, it may be said that where exophthalmic symptoms have supervened on old colloid goiters the tissue is apt to show relatively small areas of relatively highly active parenchyma, while in cases of long-standing, mild, continuous symptoms of exophthalmic goiter associated with the adenomatus type of gland, the gland throughout shows its adenomatous character with all of its parenchyma relatively more degenerated than in the previous cases.

Let us turn now to the so-called simple goiters, taking up first those of the diffuse type:

Fig. 37.

Fig. 38.

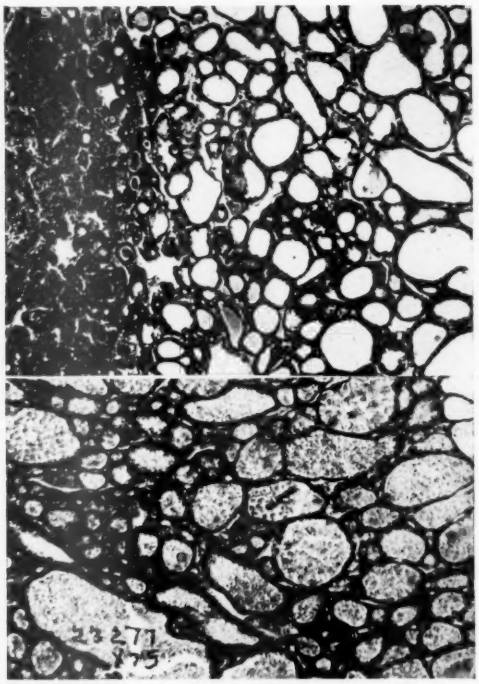


Fig. 39.

CASE 22280. Group VII. Fig. 19. This specimen represents one entire lobe weighing 170 grams. While somewhat nodular over its surface one can plainly see that the entire lobe is involved. The vessels are swollen and tortuous, the goiter being of the highly vascular type. The section (Fig. 20) shows enlarged acini with thin parenchyma lining their walls. Many of the acini are filled with stained granular secretion; a few are empty, indicating that the secretion in these places was thinner and washed out during the process of prepartion of the tissue. It will be noted also that the epithelium lining the empty acini is not so thin as that lining the filled acini. The patient is 43 years of age with a bilaterally symmetrical goiter (Fig. 21). The goiter began to develop 16 years ago and has gradually increased to its present size. It was entirely symptomless until six months ago, when some difficulty in breathing was first experienced. During the last two months there has been general nervousness and some palpitation of the heart.

Here is a case of an old, simple goiter which has recently grown enough, or has recently opened up its lymphatic channels sufficiently to permit absorption and thus produced mild symptoms of exophthalmos.

CASE 21807. Group VIII. Fig. 22. This specimen weighed 544 grams and consisted of one lobe and

Fig. 40.

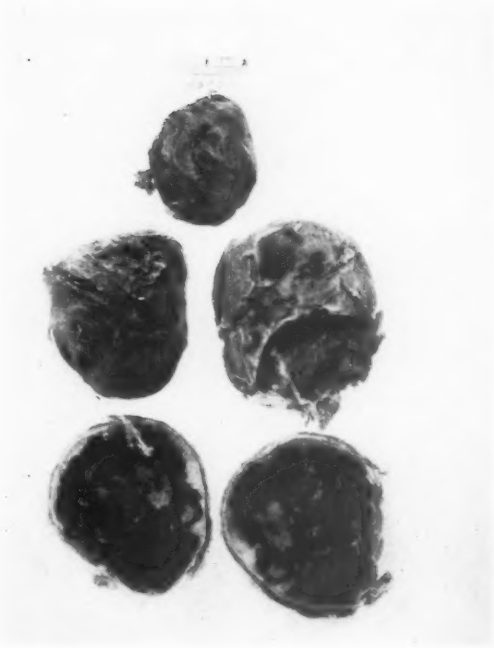


Fig. 41.

Fig. 42.

Fig. 43.

the isthmus. It is seen to be a diffusely enlarged thyroid with swollen tortuous vessel over its surface. The freshly cut surface is homogeneous and shows thick, gelantinous colloid. Histologically (Fig. 23), we find small, to very much enlarged, acini lined with flattened epithelium and filled, for the most part, with thick, stainable secretion. The patient (Fig. 24), is a woman 50 years of age, who has had a goiter on the left side for 20 years, on the right side for 15 years, and a central connecting tumor for two years. There have been no symptoms at any time except recently dyspnoea.

This case illustrates very well the ordinary diffuse colloid goiter which may involve one or both lobes, and which is symptomless.

Case 23417. Group IX. Fig. 25. The specimen from this case consists of one lobe, weighing 120 grams, which was removed in two portions. It is nodular and not highly vascular. The freshly cut surface shows dense, gelatinous colloid througout the bulk of the gland, but beginning calcareous degeneration near the center. Histologically (Fig. 26), the thick, stainable type of colloid is seen in the undegenerated areas. Clinically (Fig. 27), the patient is a woman 57 years of age, whose goiter began developing 33 years ago, during her second pregnancy. She has no symptoms, except some difficulty in swallowing and breathing. The facial appearance suggests early myxedema and her

history shows that she has gotten much "fuller in the face" in the last two years.

CASE 22693. Group X. Fig. 28. The specimen in this case consists of one lobe and the isthmus, weighing 178 grams; the surface and sectional views showing the goiter to be quite vascular in some areas and quite avascular in others, with areas of dense fibrous tissue and some lime deposits. The microscopic section, (Fig. 29 B), from a soft vascular area, shows very much enlarged irregular acini with thin walls,— from which the epithelium has desquamated,— and filled with thick, stainable colloid. A section from one of the fibrous areas (Fig. 29 A) shows the fibrous change to have taken place not only between the acini but also within them. This patient is a woman (Fig. 30) 33 years of age, who has had her goiter but eight years. Her only symptoms have been those of headache, slight dyspnœa and pain on the neck during the last few months. It is rather unusual to find such advanced degenerative changes in a woman so young and with a goiter so recent.

CASE 22567. Group XI. Fig. 32. This specimen is a single lobe, smooth, non-vascular, weighing 410 grams, and showing on fresh section almost complete fibrous and calcareous change. The microscopic picture (Fig. 33) from the edge of the tumor at first sight would be pronounced cancer. This appearance, however, may be due to the pressure of the fibrous capsule on the unyielding interior of the gland. The patient (Fig. 34) is a woman 50 years of age, whose goiter began with her first pregnancy 26 years ago, and continued to enlarge during her three succeeding pregnancies for the next 12 years, since which time there has been no change. Her only symptoms were a slight difficulty in respiration. One and one-half years after her operation she is reported in good health.

These last three cases illustrate very well the principal secondary changes, aside from cysts and malignant growths which occur in old, simple, diffuse goiters.

CASE 23267. Group XII. Fig. 35. This specimen represents an encapsulated tumor filling almost the entire right lobe and weighing 151 grams. Histologically (Fig. 36), we find it to be pure fœtal adenoma, some portions showing very recent development and others more advanced. Clinically (Fig. 37), the patient is a woman 29 years of age, who has had a gradual enlargement of the right lobe of the thyroid for the last six years.

CASE 23277. Group XIII. Fig. 38. This specimen is a spherical, encapsulated tumor removed from the right lobe of the thyroid and weighing 76 grams. Fresh section shows a smooth, solid structure. The sections (Fig. 39) from some areas show a fœtal adenoma type, similar to that of the preceding case, with gradual changing into the ordinary adenomatous tissue which in other areas is seen to be advanced with acini sowllen and filled with stainable colloid. The patient (Fig. 40) is a woman 41 years of age, who has had a gradual enlargement of the thyroid since her nineteenth year. She has had some dyspnœa at all times, with occasional nervous attacks during the past ten years.

These two cases illustrate the single nodular encapsulated tumor type of goiter which usually begins as a fœtal adenoma, and whose acini gradually fill up first with thin and later with thick gelatinous colloid.

CASE 23237. Group XIV. Fig. 41. This specimen represents four nodules with a total weight of 80 grams, which were shelled out from the left lobe of the thyroid. The microscopic section (Fig. 42) show a fœtal adenoma with the acini in various stages of development, and the edge of a cyst whose epithelium is much flattened and degenerate. The patient (Fig. 43) is a man 41 years of age, who has had his goiter for two and one-half years. During the last month he has presented some nervous symptoms.

This case is one of mutiple adenoma and is typical of early cyst formation which is very frequently present in either type of goiter. It also illustrates that clinically we may have symptoms of exophthalmos arising from the fœtal adenomata as well as from the diffuse goiters.

## THE OPERATIVE TREATMENT OF HYPERTHYROIDISM

BY C. H. MAYO, A. M., M. D., ROCHESTER, MINNESOTA
Surgeon to St. Mary's Hospital

HYPHERTYROIDISM or overactivity of the thyroid is now considered the cause of a group of associated symptoms which have been described under many different names.

The condition was described by Parry in 1825, by Graves in 1835 and Basedow in 1840, and for which Kocher now proposes the term *thyrotoxicosis*. The name commonly used, *exophthalmic goiter*, is not a good term as many of the patients do not have a goiter and others do not have a prominent eye, while some of them have neither of these symptoms in the early stage of the disease when a diagnosis might be made if these symptoms were not considered of so much importance. Many

authors, considering how little was known of the disease until the last few years, should be given credit for the bits of knowledge gained from time to time.

It was through a lack of definite or fixed pathology permitting the appellation of many descriptions and many names that aided the long delay in accepting the disease hyperthyroidism as a real condition and the opposite of hypothyroidism.

The essential feature of the condition is that the whole of the gland, or only a part, shows an overactivity from the cell changes. The cells are increased, there being more of them in the vesicles, or more vesicles. The overproduction of secretion in some of these cases must be enormous. The laboratory findings correspond with the symptoms in the greater number of patients operated upon.

The most active condition of hyperthyroidism does not necessarily require the presence of a large tumor or goiter, as, after the gland has doubled its size, the greater increase usually consists of colloid, a retention complement change occurring in the secretions retained in the vesicles. (Wilson, Am. Jour. Med. Sciences, Dec., 1908).

Such a condition has influenced older writers to state that there is no difference between the gland in Graves' disease and in ordinary goiter, while in fact, that which is retained in the gland may from its size cause trouble of various forms, because of the size of the development, but does not cause the symptoms under discussion. These are caused by a thin non-stainable secretion, the iddothy roglobulin which has been and is leaving the gland, probably by the way of the lymphatics.

Several symptoms are prominent in the disease, two of which are closely associated — tachycardia and tremor. In certain cases, during the two decades of life from 40 to 60, these without other marked symptoms, must be differentiated from myocarditis.

The eye symptoms are peculiar to the condition. The eyes may protrude greatly, or, because of the widening of the palpebral fissures, they may appear to protrude. (Stellwag.) The upper lid lags in looking down. (Graefe.) The lower on looking up. (Kocher.) The extreme protrusion may cause diplopia for near work. (Mobius.) The sudden recession of the lids when fixing the eyes upon a near point has been noted. (Landstrom.)

As already mentioned, a goiter is not an essential condition to marked hyperthyroidism. In a death from unoperated acute Graves' disease in which the thyroid was apparently normal to palpation both before and after death, the autopsy showed the gland to weigh nearly three times the normal, and to be typical in the structural changes present.

Muscular relaxation is often a marked feature. The constant exhaustion resembling that of the tired athlete, or that due to heart disease of the muscular type. In extreme cases muscular twitchings like those of chorea may be noted in addition to tremor. Gastric crisis of severe variety occurs with but little warning, and vomiting lasts from one to several days. The intestinal symptoms are those of relaxation, diarrhœa, or loose bowel movement, with but little increase in the total quantity, thus differing from ordinary toxic conditions.

The circulatory changes are marked in the increased frequency of the pulse, and in the excess of blood in the capillary and smaller vessels. The pulse ranging from 110 to 200 or more, representing the range from mild to extreme rapidity.

The extraordinary amount or proportion of the blood in the small vessels, the heart having lost the *vis a tergo*, increases the rapidity of action upon a smaller quantity of blood. Later, when the overwork and toxemia from the elimination of the disorganized epithelium of the thyroid has caused a degeneration of heart muscle, liver, spleen, and kidney, we have a dilatation of the heart with irregularity in rhythm and tension. Incomplete contraction and imperfectly closed valves with resulting pulsating large veins, and the blood pressure often drops to a low point. Fatty liver and kidney changes become marked, and we have albuminous urine, ascites, and œdematous feet and limbs, to mark this extreme condition.

The skin changes are increased feeling of warmth, sweating, with the more rapid, general metabolism manifest, and when general toxic

degeneration is present the skin, as a rule, becomes pigmented.

The hyperactivity of the thyroid may begin in early childhood; the earliest we have seen beginning in one child of four, and one of five; the latter was seven years of age when a thyroidectomy was made. A moderate amount of hyperthyroidism is not infrequent in girls at puberty and a few years following, a period of natural activity of the thyroid from sexual development. This is often true of the normal thyroid during pregnancy.

In some cases the goiter, and again the eye changes will appear early, or these may be late symptoms, while in others the goiter will have existed as a simple colloid for a long time previous to overactivity.

Unilateral exophthalmic goiter is usually that variety caused by the stimulus of an encapsulated adenoma growing in the lobe of the thyroid which later causes pressure absorption of the gland, with attacks of intermittent hyperthyroidism, and in which all the symptoms occur except that of proptosis.

The surgical treatment of hyperthyroidism must embody methods of reducing the secretion of the gland. Operating upon other tissues in the thyroid by the Jonnesco or Joboulay method of removal of the sympathetic gangleons is, because of our increasing knowledge of the disease, a method quite obsolete.

The reduction of the blood supply in the gland, or a removal of a varying quantity of the gland is at present the accepted method of surgical treatment.

In choosing a method to fit the condition, in those patients seen in the early stage of the disease, in whom thyroidectomy is not justifiable, the ligation of the superior thyroid arteries and veins on both sides seems to bring about a rapid cure. This method is also free from the possible risks of hypothyroidism from removal of the gland. It is successful in most instances and can be followed later by removal of a portion of the gland, if a recurrence of the symptoms should make it necessary.

In about two-thirds of the cases seen by the surgeon, the operation for the removal of the larger lobe and isthmus can be undertaken without undue risk. In at least one-fourth of the cases the condition is so extreme from the continued toxic condition or from acute exacerbation, that the ligation of the vessels, as advocated by Wolfler, is advisable, at least as a preliminary procedure. In a few such cases the results are astonishing. There is a relief from all symptoms and an increase within a few months, and should thyroidectomy be then undertaken, it will be done with much less risk than the former procedure of ligation. These operations we designate — *the graduated operations for hyperthyroidism.*

Some patients are in such extremis that preliminary treatment by heart-tonics, dieuretics, X-ray applications, and absolute rest is necessary before even the resort to ligation of the vessels is advisable.

Patients who have developed the symptoms of Graves' disease upon a previously existing goiter, are usually fair risks for the operation *thyroidectomy.* The condition designated as *unilateral exophthalmic goiter* is also readily treated by enucleation of the offending encapsulated adenoma. Myxoedame or hypothyroidism as a terminal stage of hyperthyroidism, may be treated by the removal of the gland to the discredit of surgeon, when the gland is already lacking in secretion.

### OPERATIVE TECHNIC

*Ligation of vessels.* A transverse incision is made in a skin crease crossing the thyroid cartilage, and the wound is deepened to the gland between the omahyoid and the sternomastoid muscles. All of the branches of the superior thyroid artery are secured at the apex of the lobe in one mass ligature which includes the superior veins as well, and in some cases, a bit of the upper pole of the gland. The ligature material is linen.

The incision for enucleation and excision is the transverse collar or Kocher incision. The incision is best placed midway between the thyroid cartilage and the sternum. The incision includes the platysma-myoides muscle which is lifted above and below with the skin flap over an area sufficient to expose the muscles covering the enlarged gland. A vertical incision now separates the hyoid muscles from the thyroid cartilage to the sternum. In cases of adenoma to be enucleated, the fibrous cap-

sule is now opened, the goiter exposed and incised to the depth of the adenoma capsule which is enucleated and the thyroid tissue closed with a locking buttonhole stitch. A temporary drain of rubber tissue relieves the tension which might occur without this provision. The wound is closed with the subcutaneous suture.

In case excision is deemed best, the sternohyoid is caught and cut between the forceps near its upper insertion, which would be above the nerve supply. If more room is required in order to expose the upper pole and facilitate the ligation of the superior thyroid artery, the sternothyroid may be treated in a similar manner. This trap-door exposure aids greatly in the elevation of the gland which is now incised along its outer border with the dissecting scissors and the tissues brushed down with gauze as the gland is dissected. The vessels as seen are caught in artery clamps. This capsule is not readily removed as it is bound to the gland at many points by the trabiculæ of connective tissue which penetrate the gland. The inferior thyroid artery may, at times, be caught before it reaches the capsule. The gland is rotated over the midline of the neck preserving the capsule and deeper tissues, recurrent larygenal nerves and parathyroid glands from injury. There seems to be but little danger from rough handling of the gland removed if the portion which is to remain is preserved from injury.

The severed muscles are united and the wound drained with spread-rubber tissue over the raw surface of the thyroid, and a tubular drain is often employed for twenty-four hours. The wound is closed as previously described.

The parathyroid bodies are four in number, as a rule, and they rest two on each side behind, or they may occasionally be connected with the capsule of the gland. These bodies should be preserved to prevent tetany, and yet it is less probable that the injury of two of them in the removal of one lobe for exophthalmic goiter would produce tetany, than that the disease would follow a similar operation for simple colloid goiter, with a partial removal of the second lobe as a primary or secondary procedure.

The anæsthetic of choice is ether. Cocaine infiltration may be substituted if the extremely serious condition of the patient demands it, or if the surgeon prefers it, or lacks confidence in his anæsthetist. If ether is used, we administer hypodermically 1-120 gr. solution of atropine and $\frac{1}{6}$ gr. morphine. These drugs allay the tracheal mucus and act as a stimulus and reduce the necessity of profound narcosis by quieting the mental distress.

The patient is placed upon a table in the reverse Trendelenburg position, the head thrown back and the shoulders elevated to render the thyroid area more prominent and accessible.

After operation the patient is given one quart of saline slowly per rectum. This is repeated twice within the next twelve hours. Should intestinal relaxation be present, we consider the salines of sufficient importance to give them subcutaneously in all severe cases. The precardial ice-bag may steady a rapid heart. Atropine checks excessive perspiration, and morphia quiets restlessness. These drugs are used as indicated above. Death from operation seldom occurs after the first 24 hours.

The employment of the graduated operation or the above-described methods of selecting the time, the preparation, and the choice of type of operation, with the careful after care of the patient, has reduced the mortality from four per cent to two.

# THYROID GLAND AND VASCULAR SURGERY

By ALEXIS CARREL, M. D., New York City, N. Y.

## I. Introduction

THE purpose of this paper is to examine what may eventually be the influence of vascular surgery on the therapeutic of the thyroid gland. Operations on the vessels of an organ permit to modify in many ways its circulation and perhaps its functions. Vascular anastomoses render possible, also, the transplantation of a whole gland. Surgery of organs is often purely anatomic and destructive. Its tendency, however, is to become more physiologic. The beautiful results obtained by Charles Mayo (1) in exophthalmic goiter by reduction of the thyroid substance and arterial ligature show what can be done by physicologic operations. A positive illustration of restorative surgery has already been given by Cristiani and Kummer (2). In a case of exophthalmic goiter, a complete thyroidectomy was performed. Then small scraps of the gland were transplanted under the skin of the acromial region of the patient. The grafts took and no accidents occurred. Three years after the operation, histological examination of the transplanted parts showed that they were in excellent condition. The field of restorative surgery is very large and still almost unexplored. Besides basedowism and myxedema, there are many other conditions of hyperthyroidism and hypothyroidism, which are still incompletely known. Hertoghe (3) in Antwerp, and Levi and H. de Rothschild (4) in Paris, have begun to study the "formes frustes" of myxedema or exophthalmic goiter. Hyperthyroidism and hypothyroidism, which occur independently of apparent lesions of the gland, or the more marked hypothyroidism, which accompany and follow sometimes goiters, are not yet treated surgically. Nevertheless, operations on the vessels of the gland may modify favorably its functions. Probably also the ideal treatment of hypothyroidism and athyroidism would be the transplantation of thyroid substance. On the success of this therapeutic, vascular surgery may have a considerable influence.

## II. Hyperthyroidism and Hypothyroidism

The activity of a gland depends in some measure on the amount and the pressure of the blood which goes through its vessels. The diminution of its arterial circulation may reduce its secretion. Many clinical observations show the disappearance of the symptoms of Graves' disease after ligature of the superior thyroid artery. The form of hyperthyroidism, described by Levi and H. de Rotschild (4) could possibly be improved by a slight diminution of the arterial circulation of the gland. Stenosis of the artery can be used when a small lowering of the blood pressure and of the amount of red blood is needed. Arterial stenosis is produced by two different methods. The simplest method consists of reducing the caliber of the vessel by suture (5). The suture permits to determine exactly the degree of stenosis. Its inconvenience is to produce a definite stenosis. If we want to give back to the vessel its normal caliber, we must extirpate the stenosed part and suture together the cut ends. Instead of using stitches, Halsted (6) obtained a stenosis by rolling around the vessel a piece of silver band. An advantage of this method is the possible re-establishment of the caliber by removal of the band. The artery dilates itself again and its normal circulation becomes normal. Stenosis is followed by a decrease of the pressure in the peripheral part of the artery, and an increase of the pressure in its central part (7). Tracings taken by Dr. Th. Janeway and Dr. R. McClure show a lowering of the blood pressure as more marked as the stenosis is narrower. The wall of the artery gives, after a few weeks, the anatomical proof of the change of pressure. The lumen of the vessel dilates itself and the wall becomes thinner. From a histological standpoint, there is a real hypoplasy. It is possible also that diminution of the blood pressure can bring about glandular modification. But at present this is more theoretical than practical. On account of the abundant arterial circulation of the thyroid it would be very difficult to appreci-

ate the degree of stenosis which can produce a modification of the blood pressure. Many experiments have still to be performed on that subject.

Hypothyroidism would possibly be improved if the arterial circulation of the gland could be increased. But it is a difficult problem. We cannot increase the caliber of the arteries. Vaso dilatation by section of the nerves is only temporary. Increase of the arterial pressure by ligature of the internal carotid and of the external carotid just above the mouth of the superior thyroid artery would be slight and probably without physiological effect. Since we cannot increase the size of the arteries or the blood pressure, an indirect method must be used. Therefore I thought that by performing a complete reversal of the circulation through the gland (5) the amount of red blood brought to it would be greatly increased since the caliber of the thyroid veins is always much larger than that of the thyroid arteries. The using of the veins for conveying the arterial blood to the gland, and of the thyroid arteries for bringing back the venous blood to the jugular, would produce an arterial hyperemia. In 1905, at the University of Chicago, I performed, with Guthrie, the complete reversal of the circulation in a case of transplantation of the thyroid gland (8). The central end of the artery was united to the peripheral end of the vein, and the central end of the vein to the peripheral end of the artery. The circulation was completely reversed since the arterial blood went to the gland through its vein and came back to the jugular through the thyroid artery. But the amount of red blood was not increased in this case for we united the peripheral end of the vein to the central end of the thyroid artery and not to a larger artery. Lately, at the Rockefeller Institute, I performed the complete reversal of the circulation on two goiterous dogs. In these cases I obtained a real increase of the arterial blood going to the gland, for I united the thyroid veins to the common carotid itself, while the superior thyroid artery was sutured to the jugular. The result of the operation is an intense arterial hyperemia, a considerable enlargement of the gland with abundant exudation of clear fluid. A drainage had been established, and for several days a large amount of fluid exudated from the wound. This external secretion varies in quantity according to the condition of the lymph channels. When all the lymph vessels are cut, and the gland completely extirpated and replanted, the exudated fluid is very abundant, mainly if the venous pressure is high. But if the blood vessels alone are cut, and the lymph vessels respected, the secretion is much less abundant. In both cases the amount of fluid diminishes progressively and stops completely after a few days. At the same time the size of the gland has a tendency to become normal again.

Hyperemia of a part of the gland can also be obtained by mere anastomosis of the peripheral end of one or two thyroid veins to the carotid or other artery. It produces the reversal of the circulation through one or two of the veins. We do not know what is the real effect of the operation on the capillary circulation of the gland. It does not produce a complete reversal of the circulation. Nevertheless, the gland presents an intense congestion. This hyperemia is temporary, for the venous wall reacts against the arterial blood pressure and becomes much thickened, the lumen being decreased in size so that several months after the operation the red circulation through the vein is diminished. But even a temporary hyperemia produces great anatomical modifications in a pathological gland. I performed four times this operation with Guthrie on dogs presenting parenchymatous goiters (9). Although no conclusion can be drawn from these observations, one of them deserves description. An old dog had two very large parenchymatous goiters, which in shape, size, and consistence were similar. He presented some general symptoms attributable to an insufficient secretion of the thyroid gland. He was extremely fat, and had lost the hair from the lumbar and a part of the dorsal regions of his skin. He slept nearly all the time, or stupidly sat in a corner of the room. The operation was performed on the inferior thyroid vein of the right goiter, the left one being observed as a control. After a few days the right goiter began to decrease in size and became harder in consistency. At the same time the animal lost his excess of fat, hair grew

rapidly on the bald spots, and he became very lively. Six months and a half after the operation he was etherized and the goiters examined and extirpated. Profound modifications had occurred in the size and the consistency of the right goiter. It presented an appearance quite different from that of the left goiter. Its upper end, however, in which the circulation had not been modified, showed a structure similar to that of the left side. Histological examination showed that the thyroid vesicles were very numerous, and the colloid substance abundant in the right gland, while few were present in the left one. Lately Dr. Guthrie (10) in St. Louis, repeated several times this same operation and confirmed completely the results we had already obtained in Chicago. He found again that the gland becomes in a few minutes very edematous, that the swelling increase for about 48 hours, and that at the end of twelve days it is about the same size as at the time of operation. He was also able to confirm the results of our first observations on partial reversal of the circulation in pathologic glands. He observed a continuation of decrease in size, so that at the end of three weeks or a month the gland did not greatly exceed a normal gland in size, and a marked modification of the general condition of the animals.

Although none of these observations are conclusive, it seems that complete or partial reversal of the circulation stimulates the thyroid gland. There are other methods for obtaining similar results. A slight degree of venous hyperemia would possibly produce it. It can be brought about by ligature or stenosis of the veins.

Tuholske (11) performed on a case of exophthalmic goiter the ligation of both superior and inferior thyroid veins. Berard (12) used partial ligation of the thyroid veins for the treatment of hypothyroidism occurring in a case of goiter. The result was a stimulation of the functions of the gland and improvement of the condition of the patient.

No definite conclusions can be actually drawn from these experiments about their eventual practical value. But if similar operations are ever attempted in clinical surgery it must be remembered that changes in the circulation, and especially in the venous circulation, may be followed by acute œdema of the gland, and dangerous forms of hyperthyroidism or dysthyroidism.

### III. Athyroidism

The only surgical treatment of athyroidism is the graft of a piece of human thyroid gland. There are two methods of grafting a gland: by simple implantation of small pieces of tissue, or by implantation of the whole organ with anastomoses of its vessels to the vessels of the host. In clinical surgery the first method only has been used. The second method is still in its experimental stage.

The graft by simple implantation has been often performed. The thyroid substance is generally taken from the sound parts of an adenomatous thyroid, or from a normal thyroid and grafted into the tissues of the patient. Although eighteen years have elapsed since the operation was performed for the first time by Lannelongue (13) on a human being, the technique is still very far to be definitely established. It is known, however, that human thyroid must always be used. Lannelongue took a sheep's thyroid because he thought that heteroplastic transplantation of glandular tissue could give positive results. Large or small fragments of the gland are used. The location of the graft is ordinarily the spleen, the bone marrow, or the subcutaneous connective tissue. The technique used by von Eiselberg (14), by Kocher (15), Payr (16) and Cristiani (17), differ widely from each other. Their methods have given few successes and many failures in Europe and in America. The graft generally does not take, or if it takes it undergoes later a secondary resorbtion. The percentage of success is very small. Nevertheless it is certain that the thyroid transplantation can be successful. On a cat Von Eiselberg transplanted the thyroid gland into the abdominal wall. The animal remained in good condition. Several months after he extirpated the transplanted gland and the animal died. This experiment demonstrated the possibility of transplanting the thyroid gland. The more remarkable experimental and clinical study has been made by Cristiani. In a splendid series of experiments he has carefully examined almost

all the causes of success or failure of the operation. He applied also, clinically, the results of his experimental work. A girl seventeen years old underwent a complete thyroidectomy, after which symptoms of myxedema developed. Then Cristiani and Charrin (18) transplanted into her substantaneous connective tissue thirty-eight very small pieces of normal thyroid gland. The grafts took and myxedema disappeared. Two years afterwards the girl became pregnant. It was then observed that several of the grafts became hypertrophied, as it happens to the normal thyroid gland during pregnancy. The girl had a normal child. After the pregnancy the hypertrophied grafts diminished in size and became again normal. Cristiani and Gauthier (19) improved also by a thyroid graft the condition of a myxedematous patient. The operations of Cristiani show the possibility of producing new thyroid organs which not only retain their vitality and functionate, but grow in time to be glandular organs of respectable size.

The explanation of the many failures of the graft can be found chiefly in the technique followed by the surgeons and sometimes in the action of the organism on his new organ. Success depends almost entirely on small details of technique, handling of the graft, its size, its fixation, etc. A small piece of thyroid is very delicate. If it is exposed to air for two minutes only, it dies. This has been clearly established by the experiments of Cristiani (20). In the cases where the operation was successful, the time which elapsed between the extirpation of the tissue and the graft was very short. A fluid which is not isotonic, or which contains toxic ions, kills the thyroid tissue in a short time. A small piece of thyroid which has been placed in an isotonic solution of sodium chloride for ten minutes does not take when grafted. Locke or Ringer solution must be used. The best fluid is serum from animal of same species, or inactivated serum from animal of different species. Cristiani has shown that a piece of gland preserved for about one hour in serum is still living. It is probable that in many operations the graft was already dead when the surgeon placed it into the tissues of the patient.

The size of the graft presents a great importance. If the transplanted piece is small, the area of central necrosis is comparatively much smaller than in a larger graft. By using very small pieces of tissue I observed that sometimes central necrosis does not occur at all. Cristiani advises to use a graft the size of a seed of wheat. It is certainly better to make many small grafts than a large one. When the graft is too large central necrosis is extensive, and after a few weeks the transplanted piece is often replaced by connective tissue.

The re-establishment of the circulation through the graft depends on its relations with the surrounding tissues. The new tissues receive their vessels from the host. New vessels can be seen penetrating into the graft on the third or fourth day after the operation. If there is a dead space full of blood around the transplanted tissue the vessels cannot reach it, and the graft does not take. Therefore the location of the transplantation must be carefully chosen. The spleen is very far from being the ideal. It is impossible to obtain a perfect hemostasis of the wound. Even when the technique of Payr is used a little blood can infiltrate itself between the splenic and thyroid tissues. By transplanting the thyroid substance into the bone marrow, and by operating in two stages, Kocher is able to graft the thyroid into a very vascular tissue without danger of hæmorrhage. But it is probable that the graft is soon surrounded by dense connective tissue. It is certainly better not to irritate so much the tissues of the host and after having selected a region, the hemostasis of which can easily be obtained, to operate in one stage. The subcutaneous connective tissue appeared to be the best location.

It is probable that in spite of a perfect technique the graft can fail. The transplanted tissue may be destroyed by the serum of the patient, as it happens in heteroplastic transplantations of the thyroid gland, when the zoölogical distance of the animals is very marked. But this cytolysis is doubtless exceptional in homoplastic transplantation. The disappearance of the graft may be due also in some cases to its inability to secure for itself a sufficient blood supply. When a piece of thyroid is transplanted from an animal into

another animal of a different but closely related species, for instance, from rabbit to guinea pig, the operation is sometimes successful. But the vascularization of the graft is very poor. The vessels do not develop as it happens when the tissue has been extirpated from an animal of same species. The thyroid tissue remains anemic and sometimes slowly disappears by lack of nutrition. It is possible that even in case of homoplastic transplantations, similar conditions can take place.

The transplantation of the thyroid with anastomoses of its vessels to the vessels of its host is a safer method. The whole gland can be grafted. Its circulation is immediately re-established and probably also its functions. The feasibility of this operation depended entirely on the development of vascular surgery. When I attempted for the first time, in 1902, to transplant the thyroid gland, with its vessels (21), the operation did not succeed, for the technique was not sufficiently perfected. But more experience and better laboratory equipment soon rendered possible the operation. In 1905 I extirpated with Guthrie the right thyroid gland of a dog and replaced it into his neck (8). The vessels were anastomosed and the circulation was re-established about half an hour after the extirpation. The red blood entered the gland through the thyroid vein and the dark blood flowed from the gland to the jugular vein through the thyroid artery. Eleven days after the operation the wound was opened and the anterior portion of the gland directly observed. Its color and consistency were normal. Eight months after the operation the gland was normal in size and consistency. It was very superficially located and progressively it became much deeper. Twelve months afterwards it was about in its normal situation. The dog was then sent to the country. The experiment showed that the re-establishment of the circulation was possible and that no necrosis occurred. But, on account of the technique I used at that time, atrophy by perivascular sclerosis may have occurred during the following years.

A successful study of the functions and the histological condition of the transplanted thyroid gland has been made by Stich (22). In 1907, in the Klinik of Garre, he performed a series of experiments on the autoplastic transplantation of the gland. In three cases he extirpated the thyroid and replanted it on the same animal. The vessels were anastomosed by the patching method or by the ordinary circular suture. He found that the circulation remains normal and that its microscopical appearance is not altered. He demonstrated also that the transplanted gland functionates normally by the following experiment. He extirpated the grafted gland of a dog 245 days after the implantation. Ten days after the animal developed symptoms of tetanie and died three weeks after the operation. The histological sections showed that the thyroid was in perfect condition.

Stich performed seven times the homoplastic transplantation of the gland, but no positive result was observed. This may be due to the action of the host on the graft, or to the technique, which is difficult on account of the smallness of the thyroid vessels of dogs. The experiments and clinical operations of Cristiani have shown that homoplastic transplantation of the thyroid is possible by the method of implantation. It is sure that the same results can be obtained by the transplantation with anastomosis of the vessels. The experiments of Stich have demonstrated that the thyroid can remain without circulation for one hour and a half and be successfully transplanted. It is important, from a practical standpoint, that the glandular tissue can be kept outside of the body for some time without undergoing any lesions incompatible with the re-establishment of its functions.

At the Rockefeller Institute I performed the extirpation of a large parenchymatous goiter and its replantation with reversal of the circulation. The thyroid veins were very much enlarged while the arteries were comparatively small. The caliber of the carotid artery was very big. I cut transversely the common carotid and united its central end to the peripheral end of the internal jugular. The central end of the jugular was sutured to the peripheral end of the carotid. The veins became enormously distended with red blood. The size of the gland increased immediately. At the same time, clear fluid exudated from the surface of the gland. The exudation was so

abundant that in a few minutes we could get 25 cc. of it, and after two days the dog was so weak that he could hardly walk. Progressively the secretion of fluid diminished and stopped completely after more than a week. The goiter is now much smaller than it was before the operation. The transplantation of a goiter is very much easier than the transplantation of a normal thyroid, for the size of the vessels is larger.

The experiments show that in the autoplastic transplantation of the thyroid the circulation of the gland is easliy re-established and remains normal for a long time. The specimens of Stich, examined 245 days after the operation, demonstrate that the healing of the anastomoses by the patching method is excellent. It is probable that the same results will be obtained also in the homoplastic transplantations. Can we hope that the results will be definite? The actual results of transplantation of vessels and organs made at the Rockefeller Institute permit to give a positive answer.

The results of the patching method (23) used by Stich can be permanent. In January, 1907, I resected a part of the anterior wall of the abdominal aorta of a dog and replaced it by a piece of peritoneum and musculus transversus. One year and eleven months after, the abdomen was opened and the aorta dissected. The circulation was normal and no evidence of the operation was detected. There was no modification of the caliber of the vessel or of the consistency and thickness of its wall. Nevertheless, by a very close dissection, an elliptic area of slightly different color became apparent. It was the muscular peritoneal flap which was so well adapted to the aorta that the location of its edges and the line of suture could not be exactly determined. The segment of aorta was resected and the continuity of the vessel re-established by a segment of the vena cava. The section of the patched aortic segment shows a lumen perfectly smooth and glistening, without evidence of the lines of suture. The arterio venous anastomoses, which are used in the transplantation of the thyroid with reversal of the circulation, give also definite results. Many anastomoses have been observed after six, seven, eight months, and even longer. In April, 1907, a segment of jugular was transplanted onto the carotid artery of a dog. In January, 1909, the dog was killed in a fight with other dogs. The dissection of the vessel showed that the transplanted vein was slightly dilated, that its wall was exceedingly thickened, and the anastomoses so perfectly healed that their exact location could not be determined from a gross anatomical standpoint. The same results were observed on a cat after the transplantation of the vena cava onto the abdominal aorta. Two years and three months ago a part of the abdominal aorta of a cat was extirpated and replaced by a segment of dog's carotid artery preserved in cold storage during twenty days. To-day the cat is in excellent health, and its femoral pulse has always been normal. The demonstration of the possibility of permanent results in transplanting glands is given by the following observation (24). In February, 1908, both kidneys of a dog were removed. The left kidney, after having been perfused with Locke solution and left for 50 minutes without circulation, was replanted. To-day, more than one year after the operation, the animal is in excellent health. The same operation has been repeated in Europe by Zaaÿer (25). Nine months after the operation the dog was in good health. The operations on the kidneys are still more demonstrative than the operations on the thyroid. The kidney is more sensitive than the thyroid gland, and there is no mistake possible in the interpretation of the result since the animal has undergone a double nephrectomy.

All these experiments show that permanent results are obtained in the anastomosis of vessels and glandular transplantations and that vascular operations can be safely used in the transplantation of the thyroid.

## IV. Conclusions

Among the vascular operations able to modify the functions of the thyroid, the ligature of the arteries alone has been used in clinical surgery for the treatment of exophthalmic goiter. Other disease of the thyroid, especially the "formes frustes" of hyperthyroidism and hypothyroidism may be improved by surgical modifications of the cir-

culation of the gland. It is very logical to suppose that we can stimulate or diminsh the activity of a gland by increasing or diminishing its circulation, and perhaps also modify its pathological reactions. But it is premature to think at present to clinical applications along these lines. The study of the question is still at its beginning and a great many of more precise experiments have still to be done.

The treatment of hypothyroidism and athyroidism by transplantation of the thyroid is more immediately promising of practical results. The feasibility of the operation has been already demonstrated. The actual problem is to render it ordinarily successful. Success in transplantation depends on two factors, biological and surgical. We are still ignorant of the biological factors of success and failure in transplantation of tissues between animals of same species. We do not know exactly what are the interactions of the organism and its new organ. It is certain that, at least in some cases, the gland adapts itself to its new owner, does not undergo any marked histological changes and functionates normally. But we do not know how frequent are the cases in which the new tissue and its host will have a pernicious influence on each other. The surgical factors can be probably controlled. It must be hoped that the technique of the graft by simple implantation will be improved. The operation is very much simpler than the transplantation with anastomoses of the vessels. However, if it is found that it cannot be frequently successful, the transplantation of large pieces of thyroid with union of their vessels to the vessels of the patient must be attempted. In this indirect manner vascular surgery may improve the results of the treatment of hypothyroidism and athyroidism.

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# THE THYROID AND PARATHYROIDS

## A Brief Summary

By J P. McKELVY, M. D., Pittsburg, Pennsylvania

THE thyroid is an unpaired organ, usually homogenous, arising from a median evagination of the floor of the pharynx, between the first and second branchial arches. In varying relation and number are the accessory thyroids.

Entirely distinct, the parathyroids are paired and arise as thickenings of the epithelium in the dorsal aspect of the third and fourth visceral clefts. While their number is usually given as four, yet recent investigations show that their number and distribution depart from the typical form in many cases. They are inconstant in number and position. They may be deeply buried in the thyroid or associated with lymphatic glands, thymic residues or accessory thyroids. The discordance in experimental results must be due to this wide distribution, their variability in number and position.

The thyroid structure, vesicles of different sizes lined by a single layer of cuboidal cells and always containing colloid, is essentially the same in all classes of vertebrates, although its size and position may show great variations. The accessory thyroids possess a vesicular structure and, no doubt, have function similar to the thyroid.

Parathyroids, according to most authors, are different structures; different histologically, of different embryological origin and, physiologically, probably subserve different functions. They vary from 4 to 8 in number, are composed of solid masses of epithelial cells which are not arranged in vesicles and contain no colloid.

The nervous supply of the gland is derived from the laryngeal nerves. No structural changes, however, have been observed in the cells as the result of stimulation or section of those nerves or the vago-sympathetic (Hill). The natural stimulus seems to be the presence or absence of some substance in the blood.

### CHEMISTRY

According to Beebe chemical studies of the gland have demonstrated the presence of three proteids: a nucleo-proteid, a globulin and an albumin. The normal thyroids contain relatively little of the nucloe-proteid, much globulin, and a smaller amount of albumin. The parathyroid, on the other hand, contains a large amount of nucleo-proteid, and small proportions of globulin and albumin. Apparently, in each case the proteid present in greatest abundance is the one most active physiologically.

The nucleo-proteid contains no iodine. The globulin or thyreoglobuin, which has been studied particularly by Oswald, contains all the iodine. It may be considered a comp-proteid containing iodine and does not yield nuclein on digestion. It is not known how the iodine is bound to the proteid. Analysis of the thyreoglobulin from various animals shows a quite constant quantitative composition, except for the iodine which may vary greatly in amount. Normal human thyreoglobulin contains about .30 per cent iodine and yields on decomposition Baumann's thyroiodin. The latter contains phosphorus, about 10 per cent of iodine and gives no proteid reaction. This is apparently the active principle of the colloid and gives results similar to those produced by extracts of the whole gland. The question is now raised, however, whether it does produce the full physiological effect of the entire glands extracts.

Despite Justin's contention that iodine is present in all cell nuclei, the work of Loeb, Cunningham, Marine and Williams, and others have shown that even after feeding iodine, the amount of iodine present in other tissues than the thyroid proper is a negligible quantity.

Estes and Cecil, with various animals and using large quantities of parathyroids for each determination, found in but three instances the slightest trace of iodine, and this in such minute quantities as to be insignificant in importance.

### IODINE

Whether the function of the thyroid is the neutralization of toxic substances or a complementary action upon intracellular meta-

bolism, there can be little question that it owes its action to its specific secretion, the colloid (Wells). The experimental work done on this subject indicates a decided and probably a quantitative relation between the amount of iodine and the physiologic activity.

All the work done by the hosts of physiologic chemists on the organic constituents of the thyroid proteids has led to the conclusion that the specific properties of the colloid are due to the contained iodine, or, to quote Marine and Williams, "the physiologic activity of the colloid is dependent on the amount of iodine contained in organic combination."

Hunt has arrived at similar conclusions in a novel way — that of testing the resistance of animals to acetonitrile or morphin with and without the administration of thyreoglobulin.

He found that iodine-free thyroid possessed only a very slight degree of physiologic activity; that with increase in iodine per cent there is a parallel increase in the degree of protection agianst acetonitrile.

The observations of Halsted on compensatory hypertrophy and the vast amount of clinical and experimental evidence of the specific therapeutic effect of iodine in goiter would point to its being an essential constituent of thyroid secretion.

Marine and Williams, in their study of the relations of iodine to structure of the thyroid, show that the per cent of iodine per gm. of fresh thyroid shows a progressive decrease from .8 mg. per g. in the normal gland through the colloids to a minimal of .023 mg. per gm. in the marked glandular hyperplasias; that there seems to be a definite minimal amount of iodine per gm. of thyroid necessary for the maintenance of the normal histological appearance of the epi, and if the iodine content falls below this, hyperplastic changes follow.

They showed that the per cent of iodine in colloid glands is inversely proportionate to the amount of thyroid and suppport the view that colloid glands are preceded by a hyperplastic state, and are to be considered as the reverted or quiescent state of a previous hyperplasia. That before this reversion can take place a necessary minimal amount of iodine must be present. Thus there seems to be a minimal normal amount of thyroid tissue and a minimal normal amount of secretion necessary for normal body economy, which is dependent on the available supply of iodine, i. e., the greater the supply of iodine, the less the necessary amount of thyroid.

Baumann has shown for normal glands that compensatory hypertrophy occurs when iodine is restricted in the diet. The latter author claims that at birth iodine is practically absent from the thyroid; it increases progressively with age to a maximum at 25–45 and then decreases. It is significant that, as a rule, the marked cases of glandular hyperplasias occur in the young and are associated with a greatly decreased iodine content. As pointed out by Halsted, it is possible to produce goiterous pups by partial removal of mother's thyroid when she is kept on ordinary diet — Marine and Williams have shown that this does not occur in the presence of full amounts of iodine.

Experiments on feeding iodine to animals (M. & W.) shows a marked decrease in weight of all the hyperplastic glands with a return to the colloid state. Normal and colloid glands show no change in size. Total iodine increases in all glands.

Thus it would seem that the pathology of simple goiter is an attempt on the part of the thyroid to maintain a certain iodine balance.

### FUNCTION

An idea as to the complete function of the thyroid gland is probably to be obtained best by studying an organism after the complete ablation of the organ. And in this connection it is to be remembered that a small portion of the gland left in the body is usually sufficient for the retaining of all the functions of the organ; this probably explains the cause of so many contradictions found in the literature.

If the thyroid gland is completely removed from the body or its function fail for any reason, the peculiar changes of myxeodema result as first described by Wm. Gull in 1874. The Reverdins and later Theodore Kocher studied the effect of the extirpation of the gland and found on the whole the same symptoms as in myxeodema — Kocher gave it the name cachexia strumipriva. Since then numberless results of thyro and parathyroidectomy have been reported of a very contradictory nature.

In most of these experiments the issue is clouded by doubt as to the exact scope of the operation, whether a parathyroidectomy included all the parathyroids, or that in a thyroidectomy parathyroids also may not have been removed. However, in spite of contradictions, the facts seem briefly to be as follows:

1. Removal of the thyroid causes cachexia thyreopriva.

2. Removal of the parathyroid is followed by acute tetany.

Hagenbach reports that in cats if the thyroid and inner parathyroid bodies be removed, the remaining outer parathyroid bodies will preserve the animal from tetany, but do not act vicariously for the thyroid, and consequently typical cachexia strumipriva results. Subsequent removal of the two remaining parathyroids is followed by pronounced tetany.

The unmistakable symptoms and metabolic changes common to cretinism, myxeodema and cachexia strumipriva and the wonderful effect of thyroid feeding in these cases make clear the far-reaching effect and influence of the thyroid on the body and mental development. The fact that the administration of the gland must be continued throughout life indicates that the nutrition of the body demands a constant supply of some substance yielded by the thyroid. This specific substance must for the present be considered thyroiodin.

Marine and Williams conclude that Halsted's experiments and observations followed by those of Horsley and Edmunds have established several important biologic facts, chief among which are:

1. That the gland is essential to normal body economy.

2. That partial removal is followed by compensatory hyperplasia of the remaining portion.

3. That myxeodema follows total removal.

4. That it is possible to produce experimentally congenital hyperplasia of the thyroid.

And the same writers (M. & W.) say it would seem "that the gland is essential to normal metabolic activities; that it probably has a definite secretion, of which iodine is an essential constituent; that the various anatomic changes occurring in the glands are results of or reactions against general nutritional disturbances rather than specifically thyroidalin origin."

The great importance of the thyroid gland for the maintenance of the healthy metabolism of the body is established, but we do not know how it acts. Upon this latter point, according to Hill, there are two chief theories: 1. The more probable one is that the gland produces a specific substance which is necessary for the nutrition of the body, especially of the central nervous system. Not only do the symptoms during life show that that system is especially affected by the loss of the thyroid, but after death degenerative changes are found in the nerve cells of the brain and spinal cord.

2. The rival theory maintains that the thyroid gland produces a substance which neutralizes or antagonizes poisonous substances produced by the metabolism of the body.

Both theories are probable and not inconsistent with each other.

It is well authenticated that thyroid feeding stimulates N. metabolism and this stimulation may be accompanied by increased oxidative capacity of the organism by which the toxic products of metabolism are rendered harmless (Beebe).

Metabolic function,—That the thyroid bears an important relation to metabolism especially of proteids is shown by the following facts:

1. Thyroid feeding causes a greatly increased elimination of N. in the form of urea which comes partly from increased tissue destruction as shown by the loss of weight and strength. There is little change in the interrelation of the N. urinary constituents. There is also increased destruction of body fat.

2. Deficient thyroid secretion in the young prevents growth which may vary in degree from infantilism to extreme cretinism. In cretinism, myxeodema and cachexia strumpriva, the respiratory exchange is reduced one half (Hill). Urinary N. is diminished, expecially the urea N. while ammonia and other forms are relatively excessive (Wells).

Underhill and Saiki have shown that thyroidectomized dogs are incapable of utilizing subcutaneously introduced dextrose in anything like the normal amount, and showed that this was due not to disturbed glycogenic function, but to the lessened oxidative activity,

thus showing a change in the metabolism similar to what has been observed in cretinism and myxeodema.

It is possible that many of the symptoms following thyroidectomy, decreased metabolism, etc., may result from decreased or incomplete protein oxidation — conversely that the thyroids exert an influence over the intracellular oxidative processes.

Stookey found that the liver, spleen and kidneys from thyroidectomized dogs had decreased power to oxidize indol. And he thinks this finding might indicate that the thyroids bear to intracellular N. oxidation a relation analogous to that existing between the pancreas and the utilization of glucose, namely, that the thyroids through their internal secretion activate the oxidative enzymes of the different body cells.

The detoxicatory function is supported chiefly by the following:

1. Following thyroidectomy there is marked ænemia with some leucocytosis (Wells) structural changes in vessel walls (Kishi) and cytoplasmic degeneration of liver, kidney and myocardium may result (Bensen). These suggest strongly the presence of poisonous substances in the blood.

2. According to Beebe during infections and chronic toxæmias the thyroid undergoes cellular hyperplasia which may serve in the nature of a compensatory hypertrophy, i. e., the additional demand for the detoxicating action of the gland results in its growth.

3. The effects of thyroidectomy are more marked in carnivores than in herbivora. Meat feeding increases the symptoms in thyroidectomized animals, especially the herbivora (Wells).

Watson has shown that a pure meat diet causes in fowls a great hypertrophy of both thyroid and parathyroid.

As it is known a meat diet decreases the iodine in the thyroid and thus probably decreases its efficiency, it might seem that its detoxicatory action depends on its influence on metabolism — that the so-called autointoxication is due to the products of incomplete proteid metabolism within the tissues when the metabolic influence of the thyroid is wanting.

### PARATHYROIDS

Despite the dissenting voices the facts seem well established that the parathyroids are independent organs with definite specific function and not developed from or convertible into thyroid tissue.

Numerous experiments show a marked difference in the results of thyroid and parathyroidectomy. If the thyroid alone is removed a slowly increasing cachexia develops which resembles Myxeodema in man. If the parathyroids alone are removed a condition resembling an acute toxæmia results, which develops rapidly and of which the most prominent symptom is muscular tetany.

The statement has been generally made that no evil results follow extirpation of the thyroid and parathyroids in herbivorous animals, and the less toxic character of the decomposition products of the food of herbivora is usually assigned as the reason.

MacCallum, Thomson, and Murphy, in their investigation of the results of parathyroidectomy in herbivora, working with sheep and goats, produced typical tetany in some of the goats, twitchings in others and no effect was noticed on the other goats; all the sheep gave negative results. The fact that the goats in whom tetany developed were young, while all the sheep were mature, may partly explain this difference.

The only explanation they offered for the negative results in so many of their cases is that in spite of careful search still other masses of parathyroid tissue were left hidden somewhere in the neck or thorax. Feeding proteid, extractives of meat, and so forth, seemed to have no influence on the outcome of the experiments.

Their experiments thus show that while it is difficult to produce tetany in herbivora by removing the main masses of the parathyroids, yet it is possible to thus produce typical violent tetany in some herbivora.

It does not seem reasonable to suppose that organs which are so clearly shown to have a special function in carnivorous and most other animals should be so highly developed in the herbivora and still have no special functional importance.

MacCallum's studies show conclusively that

parathyroidectomy in dogs is followed by acute tetany — apparently due to nervous impulse rather than muscular changes, since they do not appear in muscles from which the nerve supply is cut off. Trismus, protrusion of the eyes and air-hunger were also observed, and death usually resulted from exhaustion. That this tetany is due to the loss of some specific influence exerted by the parathyroids is proven by the disappearance of the tetany on the injection of extracts of the parathyroid, although death is not prevented. It would seem that this specific property lies in the nucleo-proteid of the gland from Beebe's experiments -- he arrested the tetany and restored the dogs to a temporarily normal condition in from 30 minutes to 2 hours by hypodermic injection of beef parathyroid nucleoproteid given while animals were in convulsions. Tetany recurring in from 24 to 60 hours could be relieved again in the same way a second and third time, but he was not able to keep an animal alive longer than three weeks after the operation, although he could always prevent death in the acute tetany.

There is some evidence that the convulsions are due to a toxic condition of the blood which appears as a result of the absence of the parathyroid.

MacCallum has shown that bleeding the animal in tetany and infusing with normal saline or transfusion will relieve the convulsions.

Beebe has shown that if the animals are fasted for a few days, or if they are fed on a meat free diet, the convulsions are less severe and appear later. Convulsions can be made to appear in two to three hours by feeding meat. And, further, the blood of an animal in tetany was found to be very toxic to an operated animal before enough time elapsed to have tetany from its own operation.

Colin Russell, in his study of the brains of dogs dying in tetany after parathyroidectomy, found slight but uniform alterations in the cortical cells. He thought these were sufficiently well marked to cause the tetany; and, since no changes were observed in other organs, he ascribed these changes to a toxin in the blood.

The almost immediate arrest of the tetany by bleeding and saline infusion speaks strongly for the presence of some poisonous substance in the blood.

MacCallum's report of the metalbolism in parathyroidectomized animals affords evidence of the existence of some type of acid intoxication. He reports:

1. An increased amount of ammonia in the blood.

2. An increase of ammonia in the urine, with a marked increase of the ammonia ratio, from 5 to 25–40.

3. An increase of urinary nitrogen.

4. A marked reduction of calcium in the tissues, especially the blood and brain, during tetany.

5. An increased output of calcium in the urine and fæces on the development of tetany.

Voegtlin found that all soft tissues of the body and the blood contain only one-half the amount of calcium found in normal dogs.

MacCallum and Voegtlin have shown that injection into a dog in tetany, either subcutaneously or intravenously, of any soluble calcium salt, will almost immediately restore the dog to normal. The calcium also acts efficaciously if fed by mouth, but more slowly.

They have shown also that sodium and potassium salts have no such beneficial action but tend to intensify the symptoms, and, while magnesium salts stop the tetany, this is masked by their extreme toxic action.

Numerous researches have shown the important relation of the calcium salts to the excitability of the nervous system.

Sabbatani showed that the direct application of calcium chloride to the cortical surface markedly reduced its irritability.

J. Loeb finds that the injection into the body of any salt liable to precipitate calcium produces twitching of the muscles.

Silvestri estimated that the calcium contents of a fœtus increased rapidly toward the end of the term and that during lactation the loss of calcium in the milk would reach about 6–7 gms. daily; thus the tetany of pregnancy and lactation is perhaps explained by the calcium deficiency produced by this drain.

Other observers have shown an increased calcium content in the urine of children suffering from tetany, and in children dead of tetany a deficiency of calcium in the tissues.

In osteomalacia and rickets, in the course of which tetany is well known to occur, there is a disturbed calcium metabolism and Erdheim has attempted to show they bear a relation to the parathyroids.

The relation of calcium to tetany seems to be established, but the action of the parathyroids is not so clear.

1. It may be that they exercise a control over the calcium metabolism so when they are destroyed the tissues lose calcium.

2. It may be that the function of the parathyroids consists in neutralizing, in some way, toxic substances formed elsewhere in the body; upon their removal the toxic substances would accumulate in the blood. We can thus imagine, as MacCallum says, an acid intoxication with excessive amounts of organic acids in the tissues which must be neutralized by alkaline substances drawn from the tissues, among which are calcium and ammonia. The calcium content of the tissues is so small that the loss of a very small amount may overthrow the balance, and thus destroy its moderating influence on the nerve cells.

There is little scientific knowledge of the real significance of the glands and their mode of functioning, most is purely empirical.

The progress of physiology in the last few years has shown that it is impossible to assign any one special function to any organ. The different organs of the body have a complex interrelation and work together for the good of the whole organism, which is the physiological unit. Nowhere is this interaction better shown than in the case of the thyroid, parathyroid, adrenals, thymus, pancreas, pituitary body and generative glands. The physiology of one cannot be dissociated from the other.

The conception that certain glandular organs may give rise to chemical products which, on entering the circulation, influence the activities of other organs, finds a wide field of application in the glands under discussion. The active substances formed in the thyroid and parathyroid may be classified under Starling's conception of specific hormones. As the latter author suggests that this means is more primitive than the later developed and better-known method of co-ordination, through the medium of a nervous system, so the remains of the ductus thyreoglossus may possibly indicate a still more primitive method of delivering these products to the organism.

Hoffman, in his study of the serum in thyroid affections, ascribes great importance to the behavior of the other glands with an internal secretion in the symptom complex induced by excessive or deficient functioning of the thyroid. He suggests that when a gland with an internal secretion is doing extra work, an antagonistic gland must increase its functioning to keep up with it or the balance is upset and the excessive functioning of the one becomes accompanied by deficient functioning of the other.

Many examples of the interaction of these glands suggest themselves. If the supposed antagonism of the adrenal and the thyroid be true, it accords with the suggestion that the frequent arteriosclerosis in myxeodema being possibly attributable to thyroid insufficiency, it is possible that other forms of arteriosclerosis may be due to relative or absolute thyroid insufficiency. As age advances the iodine decreases in the thyroid and it may be as suggested by Hunt, that the iodides may act by stimulation of the thyroid. The stimulation to growth of the mammary gland by substances passing from the embryo to the mother is also accomplished, probably by the ovary at puberty. The interrelation of the thyroid and ovarian function is manifested by the fluctuation in the size of the gland with different phases of ovarian activity.

Extirpation of the thyroid and salivary gland may cause glycosuria.

The persistence or even enlargement of the thymus in cretins and midlly beneficial effects of feeding thymus in goiter as reported by Mikulicz.

Hypertrophy of the pituitary has been noted after thyroidectomy.

This interaction and vicarious function, to at least a slight degree, is also suggested by various forms of thyroid deprivation.

Genuine cretinism and myxeodema run a chronic course and patients may attain old age.

Sporadic cretins, untreated, have a much briefer life, and cases of cachexia thyreopriva, unless relieved by treatment, terminate in death in four or five years.

It would seem that in the more acute deprivations assumption of vicarious function by related organs is less perfectly accomplished.

It is of interest in this connection that Hunt, in developing his acetonitrile test, found that the ovaries, testicles, mammary glands and prostate contained a substance acting feebly like thyroid in its relation to poisoning by both morphin and acetonitrile.

And he (Hunt) suggests that there is distributed in several organs of the body a substance or substances having a common physiologic action and that the one occurring in the thyroid has, in addition, certain chemical groups by which it is enabled to take up iodide, whereby its physiologic activity is greatly increased.

If one was to formulate a fanciful hypothesis of the function of the thyroid and parathyroid glands, one could conceive of them as being independent structures, yet the two parts of one physiologic unit. Having in common the same general relationship and interaction which, no doubt, is common to all the ductless glands, they have, as their special function, control of the body metabolism, especially of the proteins; that this is accomplished by the action of their secretions on the intracellular enzymes; that these specific substances may act as zymo-excitors or zymo-depressors to the oxidative or the proteolytic ferments of the body cells; that normally working together their nicely-balanced antagonism preserves a normal body metabolism and a disturbance of this balance resulting in a perversion of metabolism and consequent intoxication; that observed changes in the activities of the glands are efforts to preserve their normal equilibrium.

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# FREQUENCY, ETIOLOGY AND PRACTICAL SIGNIFICANCE OF CONTRACTIONS OF THE PELVIC OUTLET

By J. WHITRIDGE WILLIAMS, M. D., Baltimore, Md.
Professor of Obstetrics, Johns Hopkins University

WHILE it is a matter of general knowledge that pronounced contraction of the pelvic outlet is to be expected in certain cases of osteomalacia, spondylolistheses, and more particularly in lumbar and lumbo-sacral kyphosis my attention had not been directed to the possibility of its existence in women who presented no external deformity and in whom the usual pelvic measurements were normal, until I had learned it by several disagreeable personal experiences.

Thus, it happened several years ago that within the course of a few months, I attended two primiparæ, in whom preliminary examination showed that the usual pelvic measurements were normal, and that the fœtal head was deeply engaged. Accordingly, I stated that there was no mechanical obstacle to the birth of the child and predicted a favorable outcome, and was greatly chagrined at the time of labor to find my prognosis incorrect. In each instance, labor progressed normally until the head became visible at the vulva, when all advance ceased, notwithstanding the fact that the pains continued strong. After waiting somewhat more than an hour, and thinking that the delay was due to a rigid perineum, I applied low forceps in each case, with the expectation that a few slight tractions would effect delivery, but to my great surprise the operation proved very difficult and was completed only after most strenuous effort, one child dying from a fractured skull, while the other was born at the expense of a deep perineal tear.

On seeking an explanation for the dystocia I found that the pubic arch was greatly narrowed and the distance between the ischial tuberosities reduced to between 7 and 7.5 cm. With this experience in mind, I began to measure the pelvic outlet in all of my patients, and soon found that it was contracted much more frequently than is generally believed.

In this paper I desire to report the results of the mensuration of the outlet in 1,200 consecutive patients in the obstetrical department of the Johns Hopkins Hospital, most of whom I measured personally, and afterwards to consider the obstetrical significance, etiology, diagnosis and treatment of funnel shaped pelves.

*History.* Although Deventer, de la Motte, Smellie and other early writers mentioned isolated cases of outlet contraction, it was not until the latter part of the eighteenth century that Baudelocque and Mme. Boursier du Coudray gave anything like an accurate description of funnel shaped pelves. The former described a specimen in which the distance between the tubera ischii measured 7½ cm., and the latter in her Abrégé gave two colored figures, one illustrating dystocia resulting from a too narrow pubic arch, and the other from too close approach of the tip of the sacrum to the lower margin of the symphysis pubis. Moreover, she also mentioned a Cæsarean section performed upon a woman, in whom the tubera ischii were only 4.5 cm. apart, but unfortunately the history was not sufficiently precise to enable one to determine whether she had to do with an osteomalacic or a typical funnel pelvis.

From that time onward isolated cases were described, but it was not until the appearance of Busch's text-book and Kilian's "Geburtslehre" in 1838 and 1839, respectively, that the abnormality in question was considered under a special heading. In several reports concerning the activity of the Berlin clinic from 1829 to 1847, Busch gave notes of 35 labors occurring in funnel shaped pelves and stated that dystocia frequently occurred, and was more likely to be pronounced when the condition of the pelvis had escaped recognition, as it frequently happened when the head had become arrested at the vulva, that the obstetrician applied low forceps in the expectation of an easy delivery, but was chagrined to find that it required the expenditure of an unusual amount of force, and frequently could be terminated only after craniotomy.

Following this Ritgen, Hugenberger, Scharlau, Dedolph and others described similar cases, but their work suffered from the fact that they were uncertain of the etiology of the condition and did not possess satisfactory methods of mensuration. In 1867 Schroeder, and a little later, Spiegelburg, enunciated their views, to which reference will be made under the appropriate headings.

In 1870, Breisky described an instrumental method of measuring the distance between the tubera ischii, as well as that between the tip of the sacrum and the lower margin of the symphysis pubis. The latter method has stood the test of time, and is in general use at the present. Nine years later, Frankenhäuser made an important contribution to the subject, and described the technique of determining the length of the transverse diameter of the pelvic outlet, which was been employed in my series of cases.

The description of these methods, which made more or less accurate mensuration possible, led to renewed interest in the study of funnel pelves, as was manifested by the casuistical and statistical contributions of Fischel, Fleischmann, Roth and Mansbach, from the clinics of Breisky, Schauta, Frankenhäuser and Ahlfeld, respectively. According to these authors the distance between the ischial tuberosities was reduced to 9 cm. or less about once in every 100 cases of labor.

Schauta devoted a section to the subject in Müller's Handbuch der Geburtshilfe, and, after reviewing the existing knowledge concerning it, stated that abnormalities of the outlet were present in 5.9 per cent of 2,070 contracted pelves, which he had observed in Prag. Walther's monograph which appeared in 1894, while adding nothing essentially new to the subject, was of considerable interest in that it contained an analysis of the course of labor in 117 cases of funnel pelves collected from the literature, which he compared with his own experience in 7 cases observed in a series of 750 labors in Giessen.

In 1896 Klien made a most important contribution, and after stating that abnormalities of the outlet were present in 24 per cent of 439 consecutive patients which he studied, clearly demonstrated that the extent of obstruction at the time of labor did not depend entirely upon the degree of shortening of either the transverse or antero-posterior diameters,

ut was more frequently dependent upon the space available between a line joining the tubera ischii and the tip of the sacrum, which he designated as the posterior sagittal diameter of the outlet. He also devised an ingenious instrument for its mensuration, and formulated certain limits, below which spontaneous labor could not occur. As will appear later, I am unable to agree with all of his conclusions; but at the same time I feel very strongly that the general principles which he enunciated are undoubtedly correct and are destined to revolutionize our ideas as to the prognostic significance of funnel pelves. Unfortunately his teachings have not as yet received the recognition they deserve, as the authors of most standard text-books dismiss the subject with a few words, and, like Tarnier and Budin, merely state that funnel pelves occur but rarely and possess only slight obstetrical significance.

An equally important contribution was made by Breus and Kolisko, who, by demonstrating the frequent occurrence of lumbo-sacral assimilation and its effect upon the shape of the pelvis, have thrown light upon the etiology of certain varieties of funnel pelves, and rescued it from the vague and unsatisfactory condition it previously occupied. Their views have also found intelligent support at the hands of Bayer.

*Classification.* Schauta defined a funnel pelvis as one with a normal or only slightly contracted inlet, whose walls converge to such an extent as to lead to a marked narrowing of the outlet. In such cases he held that the contraction might involve either the transverse or antero-posterior diameter, or both diameters simultaneously; the first and last being the most usual varieties. He likewise classified funnel pelves as generally or partially contracted, according as the narrowing of the outlet involved all diameters or was limited to a single one.

Klien, on the other hand, classified such pelves according to the length of the antero-posterior diameter of the outlet, and distinguished two main categories according as it is normal or absolutely too short. In the first group the transverse diameter may be only relatively shortened while the posterior sagittal is too short, or the transverse diameter may be absolutely too small. In the second group the shortened antero-posterior diameter may or may not be associated with lessened distances between the tubera ischii.

From my own experience neither classification is perfectly satisfactory for clinical purposes, and I shall therefore distinguish between three groups: namely, typical, generally contracted, and complicated funnel pelves. In the first type, the superior strait is essentially normal, while the inferior is contracted, the narrowing occurring in either the antero-posterior or transverse diameter, or in both simultaneously, as described by Schauta. In the generally contracted variety, the entire pelvis is smaller than normal, while the inferior strait is narrowed to a greater extent than is usual in typical justo-minor pelves. In the third group are included a small number of flat or rhachitic pelves, in which the outlet contraction is superadded to the typical deformity.

Breisky, Roth and Stocker designated as funnel shaped all pelves in which the distance between the tubera ischii is reduced to 9 cm. or less, while Walther and Klien placed the limit one half centimeter higher. In this article I have adopted 8 cm. as the dividing line for two reasons. In the first place, I have never observed serious dystocia resulting from outlet contractions when the transverse diameter exceeds that measurement; and in the second place, a higher limit, in my experience, would place so many pelves in the funnel shaped category as to make its incidence appear ridiculous.

*Frequency.* The statements concerning the incidence of funnel shaped pelves vary so greatly that it is difficult to draw accurate conclusions from a study of the literature upon the subject. Thus, Stocker, Klien and Frankenhäuser stated that the distance between the tubera ischii was reduced to 9.5 cm. or less in 25, 24 and 13 per cent of their patients, respectively; while Fischel, Fleischmann and Walther noted it in only about one per cent of their cases. A similar discrepancy likewise impairs the value of the statements made concerning the relative frequency of funnel as compared with the usual types of contracted pelves. Schmidt, Schauta, Roth and Busch stated that 2, 5.9, 17 and 17.9 per cent, respec-

tively, of the contracted pelves which they studied were of the funnel variety, while A. Müller in a short note states that in his experience the latter occurs almost as frequently as all of the usual varieties combined.

For this reason, I feel that my results will be of interest, as they are based uopn my personal mensuration of 1,200 outlets in a series of 1,444 consecutive women treated in the obstetrical department of the Johns Hopkins Hospital, (cases 2,042–3,486), 670 of whom were white and the balance black, so that the material is almost equally divided between the two races.

As indicated under the heading of classification, I have designated as contracted only those pelves in which the transverse diameter of the outlet is reduced to 8 cm. or less in length, or in which the distance between the lower margin of the symphysis and the tip of sacrum falls below 9 cm. Judged by these criteria 122 funnels pelves were observed in 1,200 women, an incidence of 10.17 per cent, and may be classified as follows:

83 Typical funnel pelves..... 6.92%
34 Generally contracted funnel pelves..... 2.83%
3 Generally contracted rhachitic funnel pelves..... 0.25%
2 Flat rhachitic funnel pelves..... 0.17%

In the entire series the distance between the tubera ischii was reduced to 8 cm. in 84 cases, to 7.5 cm. in 38 cases, to 7 cm. in 14 cases, and to 5.5 cm. in one case. The single instance in which the transverse diameter was reduced to 5.5 cm. was observed in a typical funnel pelvis; and in general it would appear that the degree of contraction is somewhat more pronounced in this than in the generally contracted variety, as is shown by the following table:

| Transverse of outlet | 8 cm. | 7.5 cm. | 7 cm. | 5.5 cm. | Total |
|---|---|---|---|---|---|
| Typical funnel pelvis ... | 50 (60.2%) | 22 (26.8%) | 10 (12%) | 1 (1%) | 83 |
| Generally contracted funnel pelvis..... | 24 (70.6%) | 6 (17.7%) | 4 (11.7%) | 0 (0%) | 34 |

Upon comparing the findings in the two races it is noted that the incidence of the typical funnel pelvis is approximately identical in both; while the generally contracted variety occurs four times more frequently in colored women, as is clearly shown by the following figures:

49 typical funnel pelves in 670 whites 7.32%
34 typical funnel pelves in 670 whites
34 typical funnel pelves in 530 blacks 6.42%
A ratio of 10 to 9.
8 generally contracted funnel pelves in 670 whites..... 1.19%
26 generally contracted funnel pelves in 530 blacks..... 4.91%

A ratio of 10 to 42.

This latter observation is of more than statistical interest, and will be utilized later to justify the distinction between the two types of funnel pelves, as well as to support the contention that they are dependent upon radically different etiological factions.

*Etiology.* Up to comparatively recently the views advanced concerning the mode of production of funnel pelves were very vague and unsatisfactory, and although Breus and Kolisko had made important contributions in this regard, their teachings have not received general acceptance.

Thus, Schroeder stated that but little was known concerning the abnormality, and held that it should be regarded as a manifestation of imperfect development, particularly when the advance of the tip of the sacrum was associated with retrocession of the promontory. In other instances he was inclined to believe that the abnormality should be attributed to a kyphosis which had escaped recognition. Spiegelberg, likewise, taught that the etiology was uncertain, although he felt that the prime factor should be sought in faulty or imperfect development of the alæ of the sacrum. At the same time, he considered that the diminished inclination of the sacrum probably indicated that the transformation from the fœtal to the adult form of pelvis had not been entirely completed.

Schauta held that the condition should be attributed to some abnormality in development which had led to increased depth of the pelvic cavity. Under such circumstances the promontory of the sacrum would necessarily occupy

a higher and more posterior position than usual, so that, when exposed to the action of the body weight, the entire sacrum would rotate in such a manner that its promontory would become retropulsed, while its tip approached the symphysis, just as happens to a more marked degree in typical kyphotic pelves.

Fleischman, Bulius, Emminghaus and Richter were likewise very uncertain in their views, but were inclined to attribute the deformity to defective development, which was manifested by the infantile or masculine character of the entire pelvis later in life.

In 1900, Breus and Koliske, in the first section of their work upon deformed pelves, made a distinct contribution to our knowledge, in that they directed attention to the surprising frequency of lumbo-sacral assimilation. When the last lumbar vertebra becomes assimilated to the sacrum, they held that a pelves results in which the sacrum is made up of six vertebræ and whose promontory occupies a much higher position than usual. This they designated as high assimilation, and pointed out that such a pelvis may assume one of two forms. In the first, owing to the greater height and lesser width of the sacral alæ, its entire cavity may become narrowed transversely, although the contraction is usually more marked at the superior strait, which consequently assumes a more rounded shape. In the second variety on the other hand, the alæ retain their usual width, but the sacrum rotates in such a manner that its promontory becomes displaced backward and its tip forward, with the result that the antero-posterior diameter of the superior strait becomes lengthened while that of the inferior strait is shortened. At the same time, owing to the change in position of the sacro-iliac joints, the lateral walls of the pelves converge below, so that it becomes funnel-shaped, somewhat in the same manner as in lumbo-sacral kyphosis or spondylolisthesis. Breus and Kolisko did not attempt to explain the genesis of all funnel shaped pelves in this manner, but they nevertheless insisted that assimilation must be considered as an important etiological factor. Their views were strongly endorsed by Bayer, and to a less extent by Schmitz in 1906 as the result of the study of 20 assimilation pelves in the Giessen collection.

It is somewhat surprising that this relationship was not recognized earlier. Particularly, as close study of the copper plate illustrating the front view of a normal pelvis in Deventer's "New Light for Midwives," shows that he had to deal with a funnel pelvis, whose sacrum was made up of six vertebræ; while a similar condition was present in the specimen described by Scharlau. Moreover, Fleischmann suggested such a possibility in 1888, while Trachet in 1890 pointed out that the sacrum was composed of six vertebræ in about 25 per cent of all the dried female pelves which he examined. He, however, failed to appreciate the part it might play in the production of outlet contractions, and contented himself with directing attention to the frequent occurrence of a false or double promontory in such cases, and to the prognostic errors which might ensue if it were taken as a basis for determining the length of the diagonal conjugate.

Returning to my own experience, it would appear that the question of etiology may be studied either from an theoretical point of view or from actual observation.

As I have already indicated, the incidence of typical funnel pelves in my material was 7.32 and 6.42 per cent, respectively, in 670 white and 530 black women — a ratio of 10 to 9. So that taking the comparatively small number of cases into account, it would appear that the abnormality occurs approximately equally frequently in both races. On the other hand, the usual forms of contracted pelves,— flat, generally contracted and rhachitic — occur much more frequently in the black race, as is evident from the statistics which T. F. Riggs collected in my clinic, which show that their incidence is 9.25 and 34.8 per cent, respectively.

I have repeatedly stated that this difference can be readily explained by the much greater prevalence of rhachitis and of imperfect general development in the black women living in large cities; but as typical funnel pelves occur with about equal frequency in the two races, it would appear that they cannot be ascribed to the factors just mentioned, or to radical, social or hygienic influences. Consequently, the explanantion for their development must be sought in some factor which is common to

both races, and in the following lines I shall attempt to determine what it is.

The accompanying table shows the frequency of the several types of funnel, as well as of the other common varieties of contracted pelves in the 1,200 consecutive cases under consideration, and also the ratio in which each occurs in the two races.

| | Cases 670 | % White | Cases 530 | % Black | Ratio |
|---|---|---|---|---|---|
| Typical funnel pelvis | 49 | 7.32 | 34 | 6.42 | 10.9 |
| Generally contracted funnel | 8 | 1.19 | 26 | 4.91 | 10.42 |
| Generally contracted rhachitic funnel | 0 | .. | 3 | 0.57 | .. |
| Flat rhachitic funnel | 1 | 0.15 | 1 | 0.18 | 10.12 |
| Generally contracted pelvis | 26 | 3.88 | 80 | 15.09 | 10.40 |
| Rhachitic pelvis | 3 | 0.45 | 71 | 13.40 | 10.300 |
| Simple flat pelvis | 8 | 1.19 | 6 | 1.14 | 10.9 |
| Various pelves | 2 | 0.30 | 0 | .. | .. |
| Total | 97 | 14.48 | 221 | 41.71 | 10.29 |

From these figures it is apparent that in my material abnormal pelves of all varieties occurred in 14.48 and 41.71 per cent of the white and black women , respectively — a ratio of 10 to 29; whereas omitting the generally contracted and irregular types of funnel pelvis, the incidence becomes 6 and 30 per cent, respectively — a ratio of 10 to 50. Or, to put it more strikingly, 49 typical funnel pelves were noted in 670 white women as compared with 39 presenting the so-called common varieties of contraction; so that it is evident that the former occur slightly more frequently than the latter. In the black women, on the other hand, the conditions are reversed, as only 17.8 per cent of the total number of contracted pelves belong in the typical funnel shaped category.

Moreover, the generally contracted or justominor pelvis occurred four times, and the rhachitic pelvis 30 times, more frequently in the colored women; and this, as I have already indicated is due to the vastly greater prevalence of faulty general development and rhachitis among them. Therefore, if these factors played any part in the production of funnel pelves, the latter should necessarily occur much more frequently in the black race; but, as that is not the case, the inference is clear that they must be due to some other condition.

My experience leads me to conclude that the explanantion must be sought in high assimilation, as indicated by Breus and Kolisko, and Bayer, as it seems to occur equally frequently in both races. Since none of my patients came to autopsy, it is impossible to adduce irrefutable anatomical evidence in favor of such a contention; but, at the same time, the findings on clinical examination were such that I have no hesitation in stating that it is probably the most important and usual factor concerned in the production of the typical funnel pelvis.

In the 83 cases coming under this category, the usual external pelvic measurements were uniformly excellent, the length of the diagonal conjugate varied within the normal limits, while the only abnormality consisted in the narrowing of the pelvic outlet. In every such case I attempted to count the number of sacral vertebræ through the vagina or rectum, and in 8 instances — 10 per cent — was able to ascertain with certainty that 6 vertebræ were present — in other words, that I had to deal with an assimilation pelvis. Naturally, it may be objected that it is not permissible to infer from so small a percentage of positive findings that the abnormality was present in the majority of cases, and on general principles it must be admitted that such a contention is correct. Nevertheless, when one considers how difficult it is to count the sacral vertebræ with certainty, even with the entire hand in the vagina of an anæsthetized patient, it would seem that the relatively small number of positive results clearly indicates that the condition must occur comparatively frequently.

Moreover, in a much larger proportion of cases, I was able to detect the existence of a double sacral promontory; and my own experience, as well as the extended observation of Breus and Kolisko, shows that its presence affords almost indubitable evidence of the existence of assimilation. In view of these facts, I therefore feel that I shall not go far wrong in holding in the majority of cases, at least, that the essential factor in the production of the typical funnel pelvis is lumbo-sacral assimilation, in which the last lumbar is assimilated to the first sacral vertebræ, and thus brings about the condition so clearly described by Breus and Kolisko. Upon another occasion, however, I hope to be able to adduce indis-

putable anatomical evidence of the correctness of this view, based upon the examination of a large series of dried female pelves.

On turning to the consideration of the etiology of the 34 cases, which I have designated as generally contracted funnel shaped pelves — 8 of which occurred in white and 26 in black women — I feel that we have to deal with a totally different condition. In this group, the usual external pelvic measurements are uniformly shortened, the diagonal conjugate is reduced to 11.5 cm. or less, while the outlet is contracted to a greater extent than is usual in the typical justo-minor pelvis.

Unlike the typical funnel pelvis, the generally contracted variety occurs much less frequently in white women — a ratio of 10 to 42, which would seem to indicate that it must be due to some condition more or less peculiar to the black race. On searching for such a factor, one is at once impressed with the fact that in my series of cases the ordinary generally contracted justo-minor pelves also occurred four times more frequently in black women. As this latter type of pelves is a manifestation of imperfect general development, resulting from faulty nutrition and from the generally poor hygienic surroundings amid which the blacks grow up in large cities, I am inclined to attribute the formation of the generally contracted funnel pelvis to the same cause and to consider it etiologically as a sub-division of the justo-minor pelvis. At the same time, it is quite possible that the outlet contraction may also be partly due to assimilation, as I was able to palpate 6 sacral vertebræ in three of these cases. In that event, it would seem that two factors may be concerned in the etiology of the condition; namely. faulty general development and assimilation; whereas, had the latter alone been concerned a typical funnel pelvis would have resulted.

*Effect upon labor.* When one recalls the dimensions of the inferior strait (antero-posterior 11.5 cm. transverse 11 cm.) and those of the full term fœtal head (biparietal 9.25 and sub-occipto frontal 10.5 cm) it is apparent that more or less serious dystocia may result if either of the diameters of the outlet be materially shortened. Normally, as the head escapes from the pelvis, the occiput fills out the space included within the pubic arch, so that when the base of the occiput engages beneath the symphysis the sub-occipito-frontal diameter practically coincides with the antero-posterior diameter of the pelvic outlet, or more accurately speaking, with that of the plane of least pelvic dimensions — consequently, if the latter is materially shorter than the sub-occipito-frontal diameter, labor can be accomplished if at all, only after the head has undergone extensive moulding.

Generally speaking, more or less serious dystocia will occur when the distance between the symphysis and the tip of the sacrum is reduced to 9 cm. or less, even though the transverse diameter be normal, and will naturally become increased in proportion if the latter be shortened. The smallest antero-posterior diameter observed in my series of cases measured 8 cm. but the shortening did not give rise to dystocia for the reason that the child was macerated and weighed only 1,400 grammes.

On the other hand, if the transverse diameter be shortened, the tubera ischii are brought into closer apposition and the pubic arch becomes narrower. In this event, the sub-occipital region can no longer engage directly beneath the symphysis, but, as the contraction becomes more marked, will impinge lower and lower down upon the ischio-pubic rami so that in extreme cases the head can be extruded only posterior to a line joining the tuber ischii, which will be possible only when the antero-posterior diameter has become materially lengthened. Moreover, when labor occurs in this manner, the perineum becomes so unduly distended that delivery can be effected only at the expense of a deep laceration. Indeed it is my experience that a large proportion of complete perineal tears are attributable to such a condition.

As has already been stated, many writers consider the outlet as contracted whenever the transverse diameter falls below 9 or 9.5 cm., but I have placed the limit at 8 cm.; since, in my experience, dystocia does not occur above it unless the antero-posterior diameter is also materially shortened, which was not the case in any pelvis in my series. Moreover, it is impossible to base an opinion as to the

outcome of labor merely upon the length of the transverse diameter or upon the extent to which the pubic arch is narrowed; as I have repeatedly been obliged to apply forceps when the distance between the tubera ischii measured 8 cm., have performed pubiotomy while it was 7 cm., and yet seen easy and rapid spontaneous labor occur when it was reduced to 5.5 cm.

This being the case, the question naturally arises as to whether it is possible in any way to predict the probable outcome of labor in funnel pelvis; and the answer is that it may be accomplished with a fair degree of certainty by aid of the conceptions introduced by Klien. He holds that the pelvic outlet is made up of two triangular planes, whose bases meet at the transverse diameter of the inferior strait. Normally the head occupies the entire anterior plane, as well as the anterior portion of the posterior one; but in cases of transverse contraction less and less of the anterior plane can be utilized, while in extreme cases only the posterior plane is available for its passage. In such an event it is evident that the possibility of spontaneous labor will depend not so much upon the length of the antero-posterior diameter of the outlet, as upon the space available posterior to the tubera ischii.

Klien believed that this could be ascertained by determining the distance between the center of a line joining the tubera ischii and the anterior margin of the tip of the sacrum. This he designated as the posterior sagittal diameter of the outlet, and the corresponding distance to the lower margin of the symphysis as the anterior sagittal diameter. In 113 normal pelves these measurements averaged 9.75 cm. and 6 cm., respectively, while the antero-posterior diameter of the outlet measured 11.5 cm. With these dimensions in mind, he calculated the extent to which the posterior sagittal may vary with increasing degrees of shortening of the transverse diameter, in order to permit spontaneous labor; and stated when the latter varied between 8.5 and 9 cm. that the posterior sagittal could not fall below 7 cm., and that it should measure at least 9 cm. when the transverse diameter was reduced to 8 cm. Below this latter limit, he held that the spontaneous birth of a full term child was out of the question, and contended that, even although unmutilated children had been extracted by means of forceps through a transverse diameter of 7 or 7.5 cm. the results were so unsatisfactory for both mother and child that the operation was contra-indicated.

While I thoroughly endorse Klien's theoretical considerations and consider that they constitute one of the most important contributions to the subject, yet I cannot confirm his statements as to the normal dimensions of the diameters in question, nor the conclusions which he draws as to the prognostic significance of their variation.

Thus, in a series of 105 normal pelves, in which the distance between the tubera ischii was not less than 10 cm. I found that the average length of the anterior sagittal, posterior sagittal, and antero-posterior diameters was 5.44, 7.28 and 10.35 cm. respectively — the lowest and highest measurements being 4.5 and 7; 6 and 10; 8 and 16 cm., respectively. These figures, as well as the statement that I have never observed serious dystocia when the transverse diameter measured more than 8 cm. indicate the existence of a serious discrepanacy between my observations and those of Klien, which can be explained only by some difference in the technique employed by us in mensuration, although our methods were practically identical.

Generally speaking, in addition to the dimensions of the transverse and sagittal diameters of the outlet, the outcome of labor will depend upon the size of the child, the malleability of its head and the force of the uterine and abdominal contractions. By way of illustrating the effect of variations in these diameters, I may state that I observed spontaneous labor in one case in which the distance between the tubera ischii measured 5.5 cm., but in which the anterior and posterior sagittal and antero-posterior diameters measured 7.75, 10 and 14 cm. respectively; while I performed pubiotomy for a transverse diameter of 7 cm., when the measurements were 5, 7.5 and 10 cm., and was obliged to resort to Cæsarean section with a transverse diameter of 6.5 cm., while the other dimensions were 6.25, 7 and 11 cm. respectively. (See Figs. 6 and 7).

I have carefully analyzed my material in

the hope of formulating more gerenal rules concerning the extent to which the transverse and posterior sagittal diameters may vary and yet permit the spontaneous birth of a normal sized child, and have obtained the following results:

Spontaneous labor is unlikely to occur with a transverse diameter of 8 cm. unless the posterior sagittal measures at least 7.5 cm.

Spontaneous labor is unlikely to occur with a transverse diameter of 7 cm. unless the posterior sagittal measures at least 8 cm.

Spontaneous labor is unlikely to occur with a transverse diameter of 6.5 cm. unless the posterior sagittal measures at least 8.5 cm.

Spontaneous labor is unlikely to occur with a transverse diameter of 5.5 cm. unless the posterior sagittal measures at least 10 cm.

In other words, when the transverse diameter is 8 cm. spontaneous labor cannot be expected unless the posterior sagittal diameter possesses the average normal length of 7.5 cm., while the latter must become materially lengthened for every centimeter the former falls below 8 cm. It should, however, be remembered that these figures are only approximately correct and too much should not be expected from them; as is shown by the fact that I have been obliged upon several occasions to apply forceps when the transverse and posterior sagittal diameters measured 8 and 8.5 cm. respectively, and yet, on the other hand, have occasionally seen spontaneous labor occur when the latter diameter did not exceed 7.5 cm.

When one comes to consider the actual course of labor in our series of cases, it is necessary to differentiate sharply between that occurring in the typical and generally contracted types of funnel pelves, for the reason that in the former the dystocia is entirely dependent upon the outlet contraction, while in the latter the general small size of the entire pelvic canal is the dominant factor, so that it usually happens if the head becomes sufficiently moulded to pass through the upper part of the contracted pelvis, it will emerge from the outlet without great difficulty.

For this reason, I shall first take up the consideration of the course of labor in the typical funnel pelvis. Of the 83 patients in this category, 14 either aborted or left the hospital before delivery, leaving only 69 available for study. Of these 41 were white and 28 colored women, with 16 and 3 operative deliveries respectively, an incidence of 39 and 11 per cent, as is shown by the accompanying table:

A. WHITE

| Tubera | Total Cases | Operations | Due to Pelvis | Other Causes |
|---|---|---|---|---|
| 8 cm. | 25 | 9 | 5 | 4 |
| 7.5 cm. | 10 | 3 | 2 | 1 |
| 7 cm. | 5 | 4 | 3 | 1 |
| 5.5 cm. | .. | .. | .. | .. |
| | 41 | 16 | 10 | 6 |

B. BLACK

| Tubera | Total Cases | Operations | Due to Pelvis | Other Causes |
|---|---|---|---|---|
| 8 cm. | 16 | 2 | 1 | 1 |
| 7.5 cm. | 10 | 1 | .. | 1 |
| 7 cm. | 1 | 0 | .. | .. |
| 5.5 cm. | 1 | 0 | .. | .. |
| | 28 | 3 | 1 | 2 |

Upon analyzing these figures more carefully, it is found that the outlet contraction, per se, necessitated operative interference in 10 white and 1 colored women, an incidence of 24.4 and 3.6 per cent respectively, while the remaining operations were performed upon indications not connected with the pelvic deformity. This difference, which at first glance appears somewhat surprising, is readily explained when one recalls the fact that the infants are generally smaller and have more malleable heads in the colored race. This general rule is also borne out in this group of cases, in which two-thirds of the white and only one quarter of the colored children weighed 3,250 grams or more.

In the white women, with typical funnel pelvis there were 9 low forceps operations (cases 2531, 2576, 2737, 2805, 2860, 2861, 3000, 3314 and 3459), and one pubiotomy (case 3175); while in the colored women the single operation was the application of low forceps (case 2892). In the low forceps cases, the distance between the tubera ischii measured 8, 7.5 and 7 cm., in 7, 2 and 1 instances respectively, and the operation was undertaken only after the head had been visible at the vulva for a period varying from one and a half to three hours, and showed no tendency to advance in spite of strong, expulsive efforts on the

Fig. 1. Palpation of the pubic arch.

part of the mother. In the pubiotomy case, labor progressed rapidly and normally until the head passed below the ischial spines, where it remained without advancing for four hours, notwithstanding the fact that the labor pains were most satisfactory. In this instance the distance between the tubera ischii was 7 cm., while the anterior and posterior sagittal and antero-posterior diameters measured 6, 6 and 10 cm. respectively. The forceps delivery following the section of the pubic bone was quite difficult, and the child, which weighed 3,275 grains, bore upon its forehead a vertical pressure mark, indicating where it had been dragged over the tip of the sacrum.

The perineum was torn in 36 of the 69 cases, an incidence of 52 per cent. In itself this figure is not particularly high, but the effect

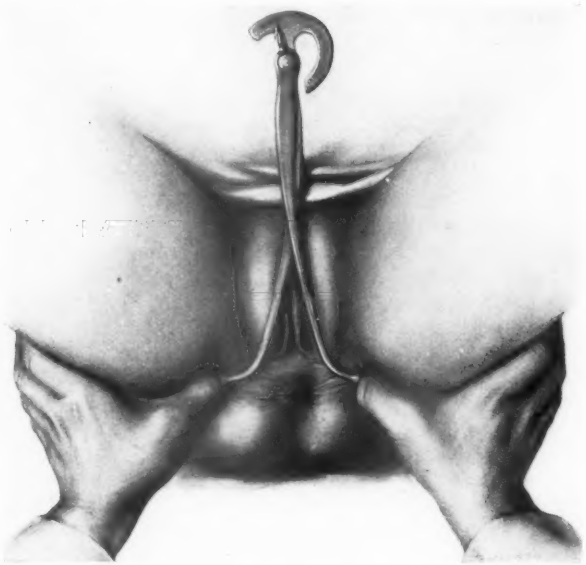

Fig. 2. Mensuration of the transverse diameter by Frankenhauser's method.

Fig. 3. Mensuration of transverse diameter with Williams' pelvimeter.

of the outlet contraction becomes evident upon analying the extent of the laceration, which was of the first, second and third degree in 21, 13 and 2 cases respectively. I am inclined to attribute the two complete tears, as well as a large part of the deep second degree lacerations, to the undue distension to which the perineum was subjected, in consequence of the mechanism of expulsion dependent upon the pelvic contraction.

Turning to the consideration of the effect of the generally contracted funnel pelvis upon the course of labor, we find that 29 of the 34 cases in this category were delivered at term — 6 white and 23 colored women. Operative interference was necessary in four of the former and six of the latter, but was due to the pelvic deformity in only two cases in each group.

In both of the white women (cases 2533 and 3377) delivery was effected by pubiotomy and

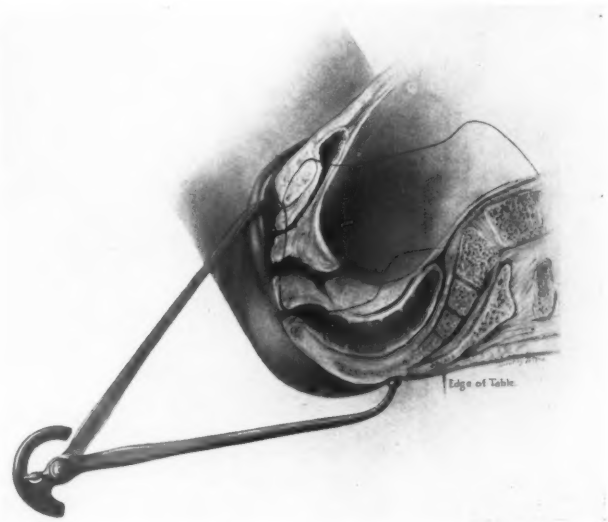


Fig. 4. Diagram showing mensuration of antero-posterior diameter by Williams' modification of Breisky's method.

the distance between the tubera ischii was 7 cm. In one case the child presented by the breech and in the other by the vertex, and in both instances the operation was undertaken with the presenting part at the superior strait. It might be objected that in these cases the interference was necessitated by the general contraction rather than by the abnormality of the outlet, and I am not prepared to deny such a possibility in the first case, particularly as I have records only of the length of the transverse diameter. In the second case, on the other hand, the outlet contraction was so marked that it would have given rise to serious dystocia had the head been able to descend to that inferior strait, as the anterior and posterior sagittal and antero-posterior diameters measured 5, 6.5 and 9.5 cm. respectively, while the child weighed 3,820 grams. Moreover, in her previous labor, which had been conducted by a thorougly competent man, a most difficult mid-forceps operation terminated in the delivery of a child with a fractured skull.

In one of the colored women in which the outlet contraction necessitated interference (case 2502), version was performed on account of prolapse of the cord, and the after-coming head had to be perforated in order to permit its extraction through an outlet whose transverse diameter measured 7.75 cm. In the other patient (case 2891) the distance between the tubera ischii was 8 cm., and the anterior and posterior sagittal diameters measured 6, 6.5 and 9 cm. respectively, and delivery was effected by low forceps.

The perineum was torn in 11 cases — 38 per cent; the lacerations being of the first, second and third degrees in 4, 5 and 2 instances respectively. Here, just as in the typical funnel group, the complete tears and a large part of the deep second-degree lacerations must be attributed to the outlet contraction.

In this group of cases the less frequent necessity for operative interference, as well as the slighter incidence of perineal injury, is attributable to the smaller size of the children.

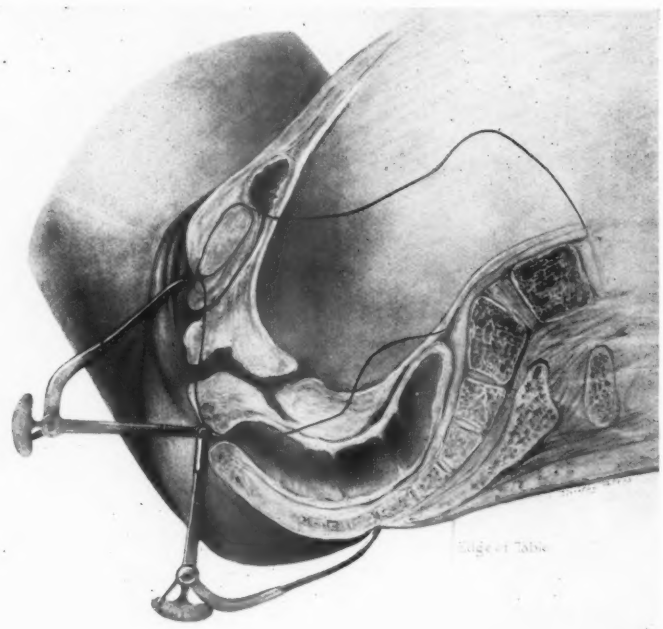

Fig. 5. Diagram showing mensuration of anterior and posterior sagittal diameters of Williams' modification of Klein's pelvimeter.

This applies not only to the blacks, as in the typical funnel cases, but to the whites as well, as only 33 per cent of the white and 22 per cent of the colored children weighed 3,250 grams or more, as compared with 66 and 25 per cent in the former group. To my mind this can be interpreted only as a manifestation of the effect of the imperfect general development of the white mothers upon the size of the child.

*Diagnosis.* In view of the comparatively frequent occurrence of contractions of the pelvic outlet and their serious effect upon the course of labor, it is manifest that it is the duty of the obstetrician to keep such a possibility constantly in mind, and to make the investigation of its condition a routine part of the preliminary examination of every pregnant woman.

An approximate idea of the distance between the tubera ischii can readily be obtained by palpation of the pubic arch as suggested by Sellheim. For this purpose the patient is brought to the edge of the bed with her legs flexed, the buttocks are then grasped with each hand in such a manner that the tissues covering the ischial tuberosities lie upon the web of the hand, while the course of the ischiopubic rami is outlined by the inner surface of the thumbs, the remaining fingers of either hand encircling the corresponding buttocks (Fig. 1). In this way the shape of the pubic arch, as well as the distance between the tubera ischii can readily be approximated so that it is possible to determine whether the former possesses a normal curvature, or is slightly or markedly narrowed, and with a slight amount of practice one can describe it as "wide," "fairly wide," or "narrow." In private practice accurate mensuration is necessary only in the last-named condition; but in hospital work it is advisable to make the accurate determination of the length of the various diameters an integral part of the routine pelvimetry.

Various methods have been suggested for determining the length of the transverse diameter. Thus, Breisky in 1870 palpated the most widely distant portions of the inner surface of the tubera ischii, and, after determining the distance between them by means of a pelvimeter, made a deduction of one half to two centimeters according to the thickness of the overlying soft parts. He admitted the theoretical objections to such a procedure, but nevertheless claimed that it gave fairly accurate results. Schroeder suggested palpating the tubera ischii, marking their outlines with a dermatographic pencil, and then measuring the greatest distance between the lines. In my experience, however, this method is even less accurate than that of Breisky, for the reason that the position of the lines must change to some extent as soon as the pressure of the palpating fingers is relieved.

Frankenhäuser in 1879 believed that the disadvantages of both these methods could be overcome if after palpating the most widely distant portions of the tubera, the thumb nails were placed in such a position as to represent the continuation of the inner surface of the ischial bones, and the distance between them measured directly with a pelvimeter (Fig. 2).

This method was employed in our series of cases and has apparently given fairly accurate results. Unfortunately, it is not available for the ordinary practitioner as it requires the services of an assistant to manipulate the pelvimeter. In order to overcome this objection I have advised a very light pelvimeter with broad, flat ends, which can be attached to the thumbs by means of adjustable rings (Fig. 3). After palpating the tubera by Frankenhäuser's method, the flat ends of the instrument are brought into apposition with the thumb nails, and the distance between them read directly from the scale. As the results obtained by its means are identical with those furnished by the original method of Frankenhäuser, I believe that the device may serve a useful purpose.

The length of the antero-posterior diameter of the outlet is obtained, as recommended by Breisky, by measuring the distance between the lower margin of the symphysis and the posterior surface of the tip of the sacrum, and afterwards deducting one or one and a half centimeters according to the thickness of the intervening bone. While making this measurement Breisky placed the patient upon her side, but I have found that equally satisfactory results may be obtained, with far less trouble, by having the patient upon her back

with the buttocks protruding a short distance beyond the edge of the table and using a pelvimeter whose blades are only slightly curved (Fig. 4).

Whenever the transverse diameter measures 8 cm. or less, or the antero-posterior 9 cm., a diagnosis of funnel pelvis should be made, while the determination of the special type will depend upon the other pelvic measurements. The typical, or generally contracted funnel pelvis being diagnosticated according as the usual external measurements and the diagonal conjugate are normal or shortened. Unfortunately, as has already been indicated, such a diagnosis gives no information as to the probable outcome of labor, so that whenever the transverse or antero-posterior diameters are shortened it becomes necessary to determine the length of the anterior and posterior sagittal diameters.

This can be accomplished without great difficulty by means of the pelvimeter invented by Klien, or by a modification which I have devised. The latter consists of a longer curved and a shorter straight blade and a horizontal bar. The latter is 5 cm. long and is so shaped that it can be conveniently held in position by two fingers of an assistant. To its center what would ordinarily be the free end of the shorter blade is attached in such a way as to permit free rotation in a vertical direction. Moreover, the lower part of this blade is made up of two portions, which are so articulated with one another as to permit the upper to rotate freely in a lateral sense upon the lower portion, which in turn can rotate vertically, but not laterally, upon the horizontal bar. As a result of this mechanism, it follows that the tip of the curved blade of the pelvimeter may be moved in any direction, while that of the straight one remains in relation with the axis of the horizontal bar (Fig. 5).

When it is desired to use the instrument the patient lies upon her back with the leg flexed and the buttocks protruding sufficiently far beyond the edge of the table to render the lower end of the sacrum readily accessible. By palpation the operator then determines the location of the transverse diameter, upon which the assistant places the horizontal bar of the pelvimeter and maintains it in position with two fingers, at the same time making sufficient pressure to keep its axis in accurate correspondence with the transverse diameter. Naturally the amount of pressure will vary considerably according to the thickness and elasticity of the perineal region. In thin women with a flabby pelvic floor practically no force is required, while in stout women with a thick and resistant perineum deep and firm pressure will be necessary. After the horizontal bar has been placed in position the operator palpates the lower portion of the sacrum, and after having determined the location of tis tip, and depresses the pelvimeter so as to bring the tip of the curved blade in close relation with its posterior surface. The distance is then read off upon the scale, and the measurement obtained represents the length of the posterior sagittal diameter, plus the thickness of the lower part of the last sacral vertebra and the skin covering it. .A deduction of one centimeter is usually sufficient to give the actual length of the diameter, although when the bone is unusually thick it may be necessary to deduct 1½ cm. Moreover, in the exceptional cases in which the coccyx is anchylosed, the measurement must be made to the tip of the coccyx, instead of the tip of the sacrum.

In order to measure the anterior sagittal diameter, the entire pelvimeter is rotated about the horizontal bar so as to bring the curved blade anteriorily, after which the lower margin of the symphysis pubis is palpated, the tip of the curved blade brought into relation with it, and the measurement read off upon the scale of the pelvimeter. In this case the layer of tissue covering the lower margin of the symphysis is so thin that no deduction is necessary. It will be remembered that my investigations show that the normal length of the anterior and posterior sagittal diameters average 5.5 to 6, and 7.5 cm. respectively.

From the description just given it will be seen that the patient may remain in the same position for the palpation of the pubic arch, the determination of the transverse diameter and the mensuration of the anterior and posterior sagittal diameters. Accordingly it is my practice to make the usual pelvic examination, to determine the mobility of the coccyx and to

measure the length of the diagonal conjugate with the patient in the usual obstetrical position, and afterwards to draw her down upon the table to such an extent that the buttocks project sufficiently beyond the edge to render the lower portion of the sacrum easily palpable. Then the pubic arch is palpated, the transverse diameter measured, and while the thumbs are still in position, the outlet pelvimeter is adjusted and the length of the anterior and posterior sagittal diameters determined, while the mensuration of the antero-posterior diameter of the outlet concludes the examination.

*Prognosis.* Upon reading the statement in most text-books one would be inclined to believe that the usual types of funnel pelvis rarely gives rise to serious dystocia, and consequently have but little influence upon the prognosis for either the mother or child. On the other hand, many of the mongraphs upon the subject convey a very different impression, and to judge from several of them one would be forced to conclude that the condition is fraught with very serious danger.

Thus, Mansbach, in a dissertation which appeared in 1891, collected from the literature the histories of 35 labors complicated by funnel pelvis and estimated that the maternal and fœtal mortality was 34 and 60 per cent respectively. Likewise, Walther, after studying the results in 117 cases described in the literature, stated that labor ended spontaneously in but 22 instances; 13.6 per cent of the mothers were lost, and that 25.7 per cent of the children were born dead, not including an additional 4.5 per cent which died within a few days after delivery as the result of fracture of the skull.

Such an appalling mortality is susceptible of two explanations. In the first place, particularly in the earlier literature, only such cases were described as had given rise to serious dystocia; while in the second many of the cases had occurred in pre-antiseptic times and therefore were much more likely to succumb to infection than at present. The correctness of this supposition is borne out by Walther's personal experience, as there were no fœtal or maternal deaths in the seven cases which he observed.

Turning to my own experience, 122 examples of outlet contraction were observed in 1,200 consecutive pregnant women, which were classified as follows: 83 typical, 34 generally contracted, and 5 irregular funnel pelvis. One hundred and three of the patients were delivered at or near full term without a death, while 7 of the children were lost. Five of them were born in a macerated condition and consequently their death could not be attributed to the condition of the pelvis; while one of the other two children perished during version and extraction from an transverse presentation, and the other from craniotomy upon the after-coming head following an attempted, rapid extraction, necessitated by prolapse of the cord.

Our results might be construed as indicating that the condition is practically devoid of danger, but closer study of our material shows that such is not the case, as a large number of children would apparently have been lost had the condition not been recognized and appropriate treatment instituted. Moreover I have indicated that the funnel pelvis is a potent factor in the production of complete perineal tears, a frequent cause of prolonged arrest of the head of the vulva, and occasionally may give rise to most serious dystocia. In the 69 full-term labors complicated by typical funnel pelvis, 9 low forceps operations and one pubiotomy were rendered necessary by the contraction of the outlet, while in the 29 cases complicated by generally contracted funnel pelvis, two pubiotomies, one low forceps operation and one craniotomy upon the after-coming head were indicated. Moreover the histories of the multiparous women showed that in previous labors many children had been born dead, as the result of fracture of the skull or following craniotomy.

Unfortunately, in the individual case, it is impossible to prognosticate the outcome of labor merely from the size of the antero-posterior or transverse diameters of the outlet, and it therefore becomes essential to take into consideration the length of the posterior sagittal diameter. On page 627, I have given the minimum length which it must present with varying degrees of shortening of the transverse diameter in order to render spontaneous labor possible. Accordingly it is only necessary to repeat in this place that a reduction to 8 cm.

in the distance between the tubera ischii should be regarded as a danger signal, and as an urgent indication for the most thorough study of the pelvis before attempting any operative procedure, as neglect in this regard may convert what promises to be an easy low forceps delivery into a most difficult operation, which can be completed only by the sacrifice of the child and occasionally of the mother as well (Figs. 6 and 7).

Generally speaking, it may be said that the prognosis is somewhat more favorably in black than in white women, owing to the smaller size and greater malleability of the heads of colored children. Likewise it is somewhat more serious in the generally contracted than in the typical type of funnel pelvis, for the reason that in the former dystocia may occur in all portions of the pelvic canal, while it is limited to the outlet in the latter. At the same time the prognostic import in the former condition may be less serious than the pelvic measurements would appear to indicate, as the imperfect general development which has resulted in the pelvic deformity may likewise manifest itself in a somewhat smaller-sized child. It should, however, be remembered that such considerations are merely of a general character, and while they hold good in a large series of cases, may nevertheless lead to erroneous conclusions in the individual woman.

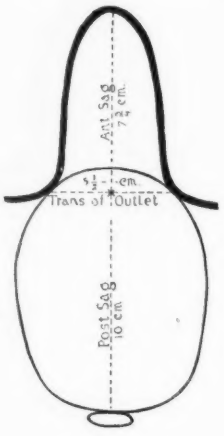


Fig. 6.

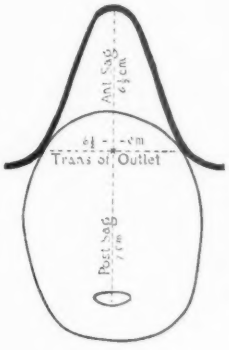


Fig. 7.

Fig. 6. Diagram of pelvic outlet, through which spontaneous labor occurred notwithstanding a transverse diameter of 5½ cm.

Fig. 7. Diagram of pelvic outlet necessitating Cæsarean section; transverse diameter of 6½ cm.

*Treatment.* As has already been indicated, a reduction in the length of the transverse diameter to 8 cm. should be regarded as a danger signal, although the actual outcome of the case can be predicted only after taking consideration the size and malleability of the child's head, and more particularly the length of the posterior sagittal diameter of the outlet.

The essential factor in the treatment of labor complicated by outlet contraction, just as in all other varieties of pelvic deformity, is exact knowledge of the extent of the abnormality prior to the onset of labor. Consequently, preliminary pelvimetry is the necessary prerequisite to intelligent treatment, as without the information obtained by its means the condition of the outlet is usually overlooked until serious difficulty, in the performance of what at first sight promises to be an almost trifling operation, leads to a careful examination and the consequent recognition of the cause of the dystocia.

Generally speaking, it may be said that the case should be treated expectantly whenever the shortening of the transverse diameter is compensated for by a corresponding lengthening of the posterior sagittal diameter, as indicated on page 627. In typical funnel pelvis, under such circumstances, the head will descend to the pelvic floor without difficulty, and, after more or less delay at the outlet, will usually be born spontaneously, although frequently at the expense of a deep or even a complete perineal tear. Occasionally the delivery may even be precipitate in character, as was strikingly illustrated in one of my cases in which the transverse and posterior sagittal diameters measured 5.5 and 10 cm. respectively, and yet the second stage was so rapid that a normal-sized child was born before the assistant on duty could reach the ward.

When the perineum is rigid, or the abdominal contractions are deficient in force, the head may soon appear at the vulva, but remain there for an indefinite period until delivery is effected by low forceps. When operative interference becomes necessary in such cases it is essential that the operator bear in mind

the peculiar conformation of the pubic arch, and make traction directly outward, or even downward and outward, instead of upward, as in low forceps deliveries, through a normal outlet. If, however, the head does not advance after a few vigorous tractions it should be assumed that it is unusually large or hard, or else that an error has been made in the measurement of the various diameters of the outlet.

Under such conditions the attempt at forceps delivery should be discontinued as persistance may lead to serious consequences — usually fracture of the child's skull, or occasionally, as in one of my consultation cases, to rupture of the symphysis pubis. If the patient is in good condition pubiotomy should be performed; while in exceptional cases in which the patient has been subjected to prolonged manipulation, or presents signs of infection, craniotomy may be the operation of choice, as the results following pubiotomy under such circumstances are so questionable as to make its employment inadvisable.

On the other hand, if the transverse and posterior sagittal diameters are so shortened as to render spontaneous or forceps delivery out of the question, Cæsarean section should be performed at an appointed time at the end of the pregnancy, or at the very onset of labor. Otherwise, in typical funnel pelvis, pubiotomy should be resorted to after the head has become arrested at the pelvic floor, while in the generally contracted type one should not always wait for such an occurrence, as the presenting part may become arrested at any part of the birth canal.

Whenever the contraction is extreme I consider that early elective Cæsarean section is the operation of choice, but contend that is is inferior to pubiotomy in patients who have been long in labor, or in whom the presenting part has descended to the pelvic floor. This conclusion is based partly upon my own experience, but more particularly upon the convincing demonstration by Reynolds that the mortality of the former operation increases directly, with the duration of labor. Both of us hold that when performed at the end of pregnancy or very early in labor, its mortality is very slight, and no greater, and possibly less than that of pubiotomy; while at the same time there is no comparison between the convalescence of the patient after the two operations, not to speak of the fact that she had been spared the strain of labor. On the other hand, my own experience has shown that the mortality of Cæsarean section, performed after several hours of second-stage pains, is many times greater than that of pubiotomy, and that the slightly more comfortable convalescence in no way compensates for the added danger of death.

Emminghaus has performed Cæsarean section successfully, under these conditions, upon a patient in whom the transverse and anteroposterior diameters of the outlet measured 5 and 7 cm. respectively. I did not have occasion to resort to the operation in this series of cases, but performed it with most satisfactory results upon a patient with a kyphotic pelvis, in which the transverse and posterior sagittal diameters measured 6.5 and 6 cm. respectively.

In the present series of cases pubiotomy was performed upon three patients. In one with a typical funnel pelvis it was resorted to after the head had become arrested just below the ischial spines, and showed no tendency to advance in spite of strong pains; while in the other two patients I had to deal with the generally contracted type of funnel pelvis, and in both the operation was done before the presenting part had descended. In the first case the child presented by the breech and a most satisfactory result was obtained. Moreover it is interesting to note that the operation was followed by a permanent increase of one centimeter in the length of the transverse diameter, with the result that a second labor terminated easily and spontaneously. In the other case the patient came to me with a history of a difficult mid-forceps delivery resulting in fracture of the child's skull. In her second labor I performed pubiotomy while the head lay at the superior strait in a posterior parietal presentation. In this instance the pelvic measurements were such that the possibility of spontaneous delivery was entertained, but, notwithstanding the fact that the pubiotomy was most successful for both mother and child, I have regretted that I did not do Cæsarean section at the onset of labor and thus have saved the patient a prolonged labor.

In all of these cases the enlargement of the outlet following the pubic section was quite sufficient to permit easy extraction of the head by means of forceps, and our results amply confirm the prediction of Van de Velde that pubiotomy should offer an almost ideal method of overcoming this variety of dystocia.

Schauta, Klien, Sonntag and others have recommended the induction of premature labor in moderate degrees of outlet contraction. In my experience the operation is rarely justified — primarily on account of the difficulty of arriving at definite indications for its performance, with the resulting tendency to unnecessary interference; but more particularly on account of the decreased vitality of the premature children. For this reason the operation was not performed in this series of cases, although it gave satisfactory results in one of my private patients, whose previous labor had been ended by one of the extremely difficult low forceps operations which caused me to undertake this study.

In rare instances the outlet contraction may be limited entirely to the antero-posterior diameter, and when its length falls much below 9 cm. serious dystocia may be expected. With the exception of the occasional cases in which the shortening is due to anchylosis of the coccyx with the tip of the sacrum, pronounced uncomplicated antero-posterior shortening is rarely observed and was not noted in any of my patients. On the other hand, it is not infrequently associated with transverse contraction, as in the cases of Emminghaus, myself and Bauer, in which it was reduced to 7, 8 and 9 cm. respectively. In the former event the treatment to be instituted will depend solely upon the length of the antero-posterior diameter, while in the latter it will be dependent upon the ratio between the transverse and posterior sagittal diameters, as the pubic arch is normal in the first and narrowed in the second case. When the antero-posterior shortening is due to anchylosis of the coccyx, serious difficulty should not be anticipated unless the distance from the tip of the sacrum to the lower margin of the symphysis is likewise materially diminished, as in most cases the dystocia can be overcome by dislocating the coccyx.

The rules which I have given for the treatment of labor complicated by funnel pelvis are based upon my own personal observations; but as they yet differ materially from those laid down by Schauta and Klien, it is manifest that radical revision of their teachings is necessary.

The former stated that Cæsarean section was indicated in primiparæ, when in suitable surroundings, whenever the transverse diameter falls below 8 cm., yet my experience indicates that such teaching is far too extreme. This is clearly shown by the fact that the distance between the tubera ischii was reduced below that limit in 28 of the 69 typical funnel pelvis cases at term, and measured 7.5, 7 and 5.5 cm. in 20, 7 and 1 instances, respectively, and yet operative interference was necessary in only five of them, — one pubiotomy and 4 low forceps operations. Moreover, the fact that there were no maternal and only 2 fœtal deaths attributable to the pelvic deformity in 103 labors, included in our entire series, clearly demonstrates that neither the mothers or children suffered. Such results, therefore, justify the conclusion that the indications laid down by Schauta were far too extreme and would be a dangerous guide in practice. Moreover, the investigations of Klien and myself have clearly demonstrated that neither the shape of the pubic arch nor the distance between the tubera ischii affords any definite clue as to the outcome of labor, and that their only value, from a prognostic point of view, is in serving as a danger signal, which imperatively demands thorough investigation of all dimensions of the outlet, and especially of the relation between the length of the transverse and posterior sagittal diameters.

Moreover, while I thoroughly endorse the theoretical considerations advanced by Klien, I cannot accept the practical deductions which he draws from them for the reason that they are contrary to the results of my own experience as laid down in this paper. For example, he contends that spontaneous labor cannot occur with a distance of 8.5 to 9 cm. between the tubera ischii unless the posterior sagittal diameter measures 7 cm.; while the extraction of a normal-sized head is absolutely out of the question should the latter be reduced to 6 cm.

This is diametrically opposed to my own observations, as I have not encountered serious dystocia when the transverse diameter exceeded 8 cm. no matter what might be the length of the posterior sagittal diameter.

Again, he states, "Since with a distance of 8 cm. between the tubera ischii the full term head must utilize for its exit almost the entire available space posterior to the transverse diameter, it must follow that its diminution below 8 cm. indicates that the space is absolutely too small to permit the passage of an unmutilated full-term head. I believe that we are justified in promulgating such a law, even though cases are on record in which unmutilated full-term children have been extracted by means of forceps through a transverse diameter of 7 or 7.5 cm. In these cases, however, the results for both mother and child are so discouraging that its use should be held to be contra-indicated."

I regret that I cannot accept these conclusions, but they are absolutely opposed by my own experience. This is clearly demonstrated by the fact that the distance between the tubera ischii was reduced to 7.5 cm., or less in 28 of the typical and 9 of the generally contracted funnel-shaped pelvis in our series, and yet operative interference was necessary in only 6 and 2 cases respectively. Moreover, in one instance rapid spontaneous delivery occurred through an outlet, whose transverse diameter was shown by repeated examination to measure only 5.5 cm.

As has already been indicated, I am at present unable to offer a satisfactory explanation for such a discrepancy, and can only express the hope that future investigations, which may be stimulated by this report, may reveal its source.

*Conclusions.* 1. Funnel-shaped pelves frequently give rise to more or less serious dystocia, are an important factor in the causation of deep perineal tears, and occasionally convert what promise to be easy low forceps deliveries into most difficult and dangerous operations.

2. Typical funnel pelves, in which the usual external measurements as well as those of the superior strait are normal, while the distance between the ischial tuberosities measures 8 cm., or less, were observed in 6.92 per cent of 1,200 consecutive pregnant women, and occurred with equal frequency in both the white and black race.

3. Generally contracted funnel pelves, in which shortening of the usual external measurements as well as of the diameters of the superior strait is associated with a distance of 8 cm. or less between the ischial tuberosities, occurred in 1.19 per cent of the white and 4.91 per cent of the colored women, being 4 times more frequent in the latter.

4. Typical funnel pelvis constituted 55.7 per cent of all cases of pelvic deformity in white, as compared with 17.8 per cent in colored women, and therefore are of especial practical importance in the former.

5. While a shortening of the transverse diameter of the outlet to 8 cm., or less, indicates the existence of a funnel pelvis, it should be regarded merely as a danger signal; as the possibility of dystocia will depend upon the relation between its length and that of the posterior sagittal diameter. The latter is the distance from the center of the former to the tip of the sacrum, and must increase in length as the transverse diameter becomes shortened.

6. Typical funnel pelves are apparently due to the presence of 6 vertebræ in the sacrum — so called high assimilation, which so changes the relations at the sacro-iliac joints as to permit the lower portions of the innominate bones to approach one another. In the generally contracted type the outlet contraction probably represents only an exaggeration of the faulty development which characterizes the entire pelvis.

7. In view of the frequent occurrence of funnel pelves, palpation of the pubic arch should form an integral part of the examination of every pregnant woman. Whenever it appears to be narrowed, the distance between the tubera ischii should be measured, and when it is 8 cm., or less, the length of the anterior and posterior sagittal diameters should also be dertermined. Only by so doing can one avoid being occasionally placed in the unenviable predicament of being obliged to resort to a serious obstetrical operation after having assured the patient that her pelvis was normal.

8. Fortunately the great majority of labors complicated by funnel pelves end sponta-

neously. In the lesser degrees of contraction low forceps may give satisfactory results, while in the more pronounced cases the operation of choice is Cæsarean section at the end of pregnancy, or pubiotomy after the head has reached the pelvic floor.

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# DEPARTMENT OF TECHNIQUE

## A NEW DEVICE AND METHOD FOR ADMINISTERING ETHER

By ALBERT H. MILLER, M. D.
Visiting Anæsthetizer to the Rhode Island and St. Joseph's Hospitals, Providence, Rhode Island

While the following method of administering ether has been thoroughly tried, it may be properly called new, as it is here described for the first time. It was first used by the present writer in June, 1906, and since that time has been employed, in hospital and private practice, in over 6,000 cases.

The apparatus is very simple. It consists of:

1. An open cone.
2. A ring of sheet aluminum.
3. A handkerchief and diaphragm of gauze.

1. The cone is made from three sheets of newspaper, folded to form a flat strip six inches wide. This strip is folded on itself to form a funnel which, when flattened out, has a breadth of six inches. This funnel is covered with a towel.

2. The ring is made from a strip of 28-1000 sheet aluminum, two inches wide and fifteen inches long. This strip is bent to form a ring which is adjustable in size. The ring may be made of brass and silver plated.

3. The handkerchief is a piece of No. 1 surgical gauze, three feet by eighteen inches. The diaphragm is composed of eight layers of the same gauze, four by six inches.

To administer ether by this method, which is styled the "handkerchief method," the cone is prepared as follows:

Place the diaphragm over one end of the cone. Adjust the aluminum ring to a size a little smaller than the inside of the cone. Place the ring over the diaphragm and push it inside the cone, carrying the diaphragm to the full depth of the ring. Pull the ring open as far as possible, fixing the diaphragm in the cone. At one end of the cone, we now have a chamber, its sides formed of the thin sheet of aluminum, its floor formed of eight layers of gauze, and its roof free. The roof of this chamber is the distal end of the cone.

Fit the proximal end of the cone closely to the patient's face. Moisten the gauze handkerchief with a few drams of ether. Beginning with one corner, introduce the handkerchief gradually into the chamber. Thus the patient becomes very slowly accustomed to the ether vapor. Pour ether slowly on the gauze handkerchief in the chamber until the patient is completely etherized. Do not remove the cone from the face until the anæsthesia is complete. If this procedure is carried out slowly,

1. 2. 3.

1. The first step in covering the open cone.
2. Pushing the aluminum ring and the gauze diaphragm inside the cone.
3. Introducing the handkerchief into the cone.

there is no coughing, choking, or feeling of suffocation. The supply of air necessary for respiration is not interfered with and the amount of ether vapor inspired is imperceptibly increased.

During the operation, ether is added constantly, drop by drop, or is poured on the handkerchief frequently in small quantities, at the distal end of the cone, or through the proximal end, on removing the cone momentarily from the patient's face. The handkerchief is frequently taken from its chamber and shaken out. In this way the evaporating surface is kept free and the amount of ether remaining on the handkerchief is frequently noted. The eyes are not covered.

This method has the following advantages:

Simplicity.

Cleanliness.

Continuous administration of ether.

Evaporating surface at some distance from patient's face.

No interference with free air supply.

Perfect and constant control over the amount of ether vapor inspired.

Economy.— No ether is wasted by soaking into the cone or by running down the face and neck of the patient.

This method answers admirably for the ethyl-chloride-ether or gas-ether sequence.

The ethyl-chloride-ether sequence is administered in the following way: The cone and handkerchief are prepared as for administering ether alone. The cone is fitted to the patient's face. Pure ethyl-chloride, in the container specially designed for narcosis, is sprayed to the amount of about 2 c.c. on the side of the ether chamber of the cone. The anæsthesia is carried only to the stage of unconsciousness, detected by inability to reply to questions. The ether handkerchief is placed in its chamber and ether is administered more rapidly than when giving ether alone, so that anæsthesia is complete in one to five minutes.

For the gas-ether sequence, the cone is prepared in the same way. Nitrous-oxide is administered with an ordinary inhaler to the stage of unconsciousness. The cone replaces the inhaler and ether is administered so rapidly that anæsthesia is complete in one to three minutes.

This appliance and method have been used at the Rhode Island and St. Joseph's Hospitals and in the writer's practice for two years. It has appealed to medical men who have seen it employed, as a great improvement over former methods.

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## THE ADHESIVE CORSET AS A SURGICAL DRESSING[1]

By C. F. WEINBERGER, A.B., M.D., Chicago,, Illinois

The use of adhesive strips in surgical dressings is of long standing. They are applied probably more frequently in office dressings and private practice than in hospitals, because of their convenience in emergency dressings. The various shapes and sizes into which the ever-ready adhesive plaster has been cut are as numerous almost as the patients on whom they have been used.

The corset-effect of the adhesive plaster also is not of recent origin and the purpose of this paper is not to be first in the report of the use of it. We lay no claim to any originality in this report, except in perhaps some of the modifications, or rather accessories, which we have added to the corset plasters and their extensive use to which we have been enabled to put them at the North Chicago Hospital, by virtue of these accessories.

The corset-bandage was introduced in our institution a little over a year ago, first in laparotomy wounds, in the following manner:

Two pieces, each about 6 x 8 inches, were cut off the sheet of adhesive plaster, and about one inch along the narrow border was turned over for reinforcement. Into this reinforced border four or five shoemaker's eyelets were inserted by a perforating forceps. These strips were then applied to the abdominal wall with the perforated borders parallel to the incision and about two inches each removed from it. Ample space was thus provided for the sterile sponges or pads to be directly applied to the wounds. By means of tape, which was passed through the eyelets, the adhesive strips were drawn together sufficiently to bring the parts in close apposition, giving thus the corset-effect. This constituted the entire dressing.

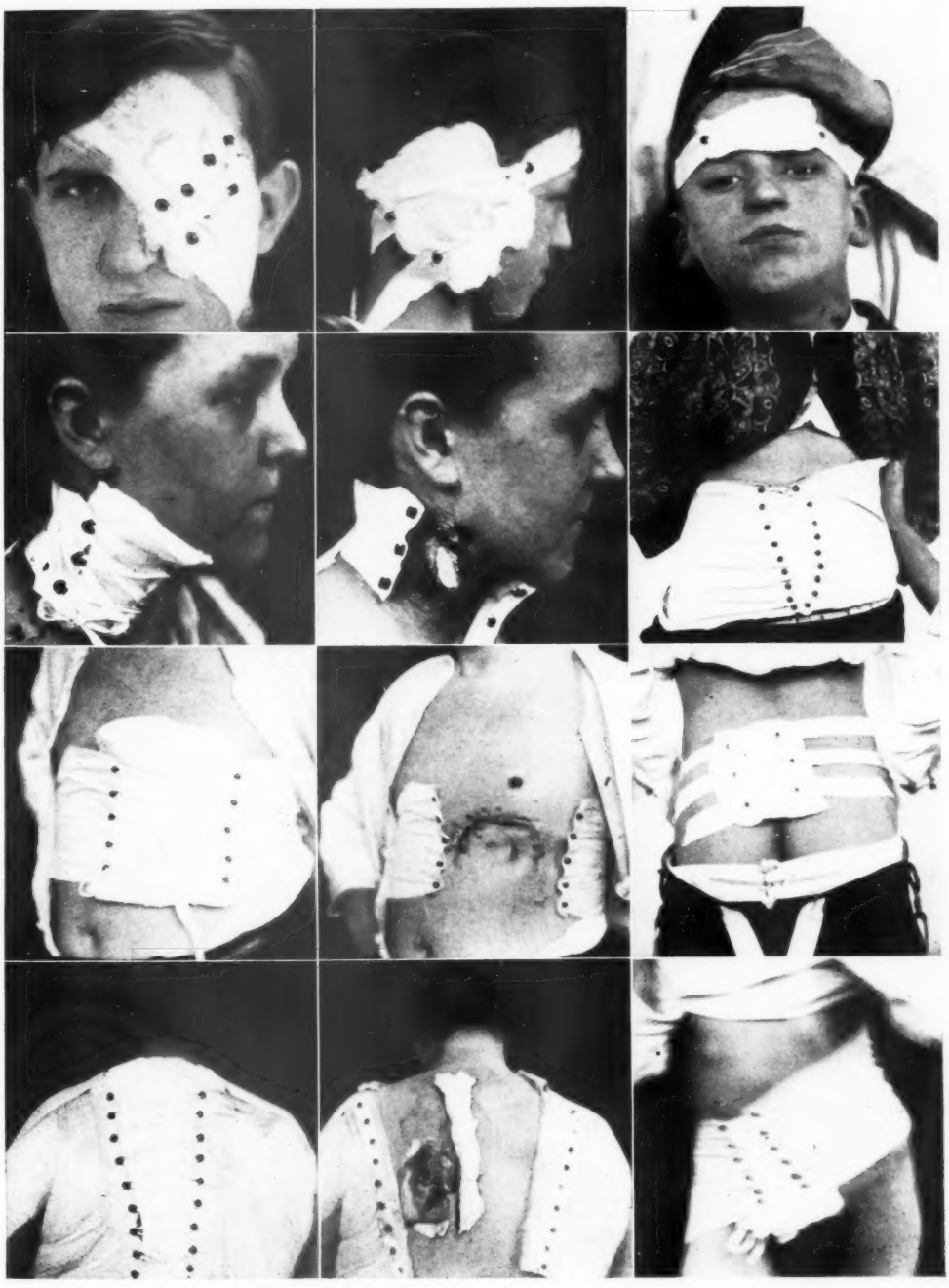
The following proved to be its advantages, viz.:

1. Its simplicity.

2. Its inexpensiveness.

3. Its convenience in wounds which required daily dressings. It must be mentioned in this connection, that it was found desirable to leave

[1] From the Surgical Clinic of Dr. Carl Beck, North Chicago Hospital.



Photographs representing the application of the dressing to various parts of the body.

off this style of dressing in cases in which there was too extensive a discharge, as, for instance, in septic appendectomies or cholecystotomies, in which the discharge would soak through the pads. But this objection holds good only for a few days usually and the corset-dressing recommends itself very soon because of the following additional advantages:

4. That in those wounds in which no primary union can be attempted a mechanical device is necessary which will hold the parts together while the dressing is in progress, so as to prevent the tearing apart of "bridges" which might have formed from day to day. This mechanical device the corset-dressing affords if the first and last tape are left in situ during the dressing, having always enough space between them to remove the soiled sponges and drainage material.

The shoemaker's eyelets very soon suggested the shoe-lacing hooks and recently we have used these only. The whole being prepared for us by a surgical dressing manufacturer. This last modification has proved to be a decidedly practical point and has induced us to use this style of dressing in an almost endless variety of wounds.

By making our strips to suit the case — in some cases using very narrow ones, with only one hook — we are now using this dressing to a decided advantage where it is very difficult, or almost impossible, to apply the ordinary bandage, and find it a very grateful feature with the patient who usually objects to a "way-around" and heavy bandage.

The accompanying illustrations suggest some of the regions and the manner in which the corset-dressing can be used.

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## AN ORIGINAL METHOD OF EXAMINING THE GALL-BLADDER THROUGH A VAGINAL INCISION

By W. B. REID, M.D., Rome, New York

The study of the end results following various diseases, in the pathological laboratory, although of inestimable value scientifically, has not always been of practical value to the living patient, because such deductions have sometimes the tendency of discouraging early effective efforts, and encouraging pessimistic therapeutic nihilism. The study of the living pathology at the operating table has been one of the strongest links formed in the chain of modern scientific surgery.

It was the exact knowledge of the living pathology of appendicitis, learned beside the operating table, which placed the effective early surgical treatment of this disease on a rational and scientific basis. Judgment, in regard to the true value of any new technical suggestion, should be passed from the viewpoint of what real benefit it may bring to the patient without, at the same time, scorning or neglecting the possible scientific influence. We should remember that the patient seeks the aid of surgical treatment, sometimes for the alleviation of suffering, but most often for the radical cure of disease; surgical methods are sought, not for the purpose of having a special operation performed, but such recourse is appealed to with the prime object of being symptomatically cured.

The intimate functional relation of the pelvic organs, through the sympathetic nervous system, with the stomach, and the latter, through the same source, with gall-bladder diseases, the appendix, et cetera, often masks the clinical history to such an extent that it is sometimes impossible to make a complete and exact surgical diagnosis

except on the operating table. The positive diagnosis of the cause of a given pyloro-spasm many times can only be made when within the abdomen. An aversion to the practice of making an exploratory incision, with its sometimes unnecessary inconvenience, incapacity, and suffering, suggested the following method of examining the intra-abdominal organs when operating through a vaginal incision. The practical application of the method originated in the case of an old lady, suffering from a pyloro-spasm and complete procidentia uteri, who presented such a mixed clinical history that it was impossible on extra-abdominal examination to settle the question of the cause of the stomach trouble. The history was strongly suggestive of appendical or gall-bladder disease, and the question was not definitely settled until after an examination made during the course of a vaginal hysterectomy, in the following manner:

The cervix was grasped with volsellum forceps, drawn out of the vagina, the classical circular incision of the uterus made, and the latter separated from the neighboring organs by blunt dissection with gauze over the finger. After freeing the bladder from the uterus, provision was made, by wide sweeps of the finger, for a free opening through the peritoneum. After incising the peritoneum, a cat's-claw retractor delivered the fundus of the uterus out of the peritoneal cavity and it was allowed to drop on the sterile towel below the vagina. The right hand was then passed through the incision, the cæcum grasped, drawn down and out of the opening with the fingers. The appendix was found post-cæcally, small and apparently normal. The bowel was returned with the same hand, through the opening, the forearm inserted far enough so that the gall-bladder was palpated and found to be normal. The pylorus and both kidneys were then palpated and found normal.

If, in the course of such examination, gall stones or other disease conditions are found, the question of any necessary abdominal incision is definitely settled.

After completing the intra-abdominal examinations, squares of gauze were passed above and below the arm and put in place by the hand to keep the intestines out of the way. The operation may then be completed according to the technique of the individual operator.

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# SUPPURATING FIBROIDS FOLLOWING DELIVERY

By ERNEST A. HALL, M. D. C. M., L. R. C. P., Ed., F. R. S. M., Lond., Vancouver, B. C.

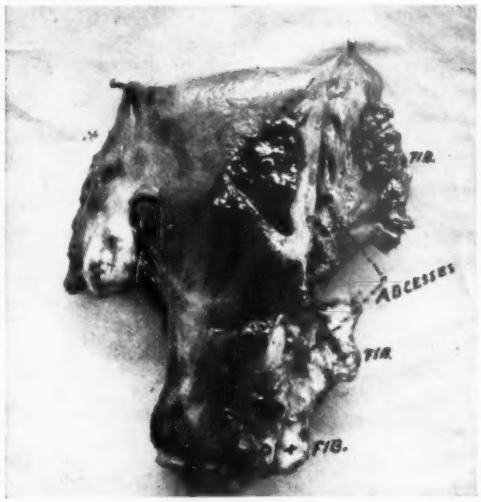
Many of us can look back to deaths following confinement in which the symptoms resembled those of a perforated appendix, or other acute pelvic infection, in which no attempt was made to deal surgically with the case. There are certain symptoms which when grouped to the experienced clinician speak in no uncertain tone, and whether it be in the puerperal woman or the virgin the call is not to be ignored. The puerperal condition should not necessarily in itself be a barrier to the application of modern methods carefully and judicially applied. An accurate diagnosis is as desirable in puerperal sepsis as in other septic pelves, but an actual knowledge of the definite pathological condition is not a matter of such near moment as the recognition of a condition that makes surgery imperative. With the light that Trendelenburg has thrown upon that hitherto obscure condition, pelvic thrombo-phlebitis, we have reason to hope that the complete chapter of puerperal sepsis is not beyond conquest. But many of us still learn by our failures.

I herewith report a fatal case from which a few lessons may be learned. Mrs. —, aged 27, third confinement. During latter months of pregnancy she had suffered severe pain in the right iliac region, and during labor the pain was continuous and excessively severe during uterine contractions.

Delivery was tedious; assisted with instruments under strict aseptic measures. After-pains were absent until the third day, when without any preliminary chill the temperature rose to 104, with excruciatingly painful uterine contraction. Removed to the hospital. Vaginal examination showed an irregular mass to the right of the uterus and firmly in contact with it. The temperature continued high, in spite of salines and hot douches. The mass slightly increased in size, no fluctuation was discoverable. After a few weeks of treatment, the temperature continuing high and the patient losing ground, I decided to open directly above the mass.

The omentum, "the policeman of the abdomen," had become adherent to the right appendage and uterus, completely shutting off the abdomen from the right pelvis.

After thoroughly packing off with gauze, the freeing of the omental adhesions showed two small interstitial fibroids with sinuses discharging pus; a third small fibroid was found within the cervical muscle. There was no communication with the endometrium; other organs were normal.




Puerperal suppurating fibroids.

The uterus was removed and after irrigation a drain was inserted into the vagina. Death from acute sepsis followed in thirty-six hours.

The educative value of analysis of surgical mistakes is frequently greater than that of statistics of successful cases, and an admission of the limitations of the personal factor in surgery may at times be wholesome.

Then what course should have been pursued in this case? In the consideration of these matters it is well to determine if possible nature's intentions and purposes, as many of her so-called pathological processes are really processes of conservatism and repair, and require to be encouraged rather than disturbed. This applies to the mass of omentum with which nature had covered the diseased parts, thus completely shutting off the diseased area from the abdomen above. This marked the danger line: we must learn to respect adhesions, and keep hands off unless there are definite indications to the contrary. After determining that there were no secondary foci of infection above the brim of the pelvis, no abscesses among the intestines, the abdomen should have been closed without disturbing the adhesions, not even to determine the nature of the mass below the omentum, and an approach made from the vagina and the parts drained, either through the cul-de-sac or by separation of the cysto-cervical attachment. Further operative procedure should have been postponed until pulse and temperature had been normal for some time and the patient recovered from the primary sepsis and exhaustion. Or, after having found the two suppurating fibroids and the side of the uterus septic, a drain might then have been passed into the vagina and the parts not further disturbed.

This is the second case of puerperal suppuration within the uterine wall that has received treatment in the Victoria City Hospital since its establishment twenty years ago. The first occurred in the service of Dr. Davie. The case had run a septic course, exploration of the uterus revealed no cause, the appendages were then examined with a negative result, Dr. Davie then concluded that the trouble lay within the uterine substance. Hysterectomy revealed an abscess within the muscular structure of the uterus.

Although the uterine contractions were possibly responsible for the diminution of the circulation to the fibroids, we cannot exclude an element of septic infection from without, although the labour had been conducted in accordance with modern asepsis, the patient's surroundings were unfavorable.

The literature upon this subect at my disposal is very limited. Noble, of Atlanta, in a paper before the American Gynecological Society, May, 1906, stated that the history of these cases shows that the expectant plan of treatment promises nothing — they all die. Hysterectomy gave a mortality of 25 per cent. The patients in drainage cases all recovered. It is but reasonable to suppose that abscesses in the uterus should be treated as similar pus collections elsewhere, that is on general surgical principles. Exception should be made, however, in cases of multiple abscesses, for the chances of successful drainage are doubtful. Besides the musculature of the uterus in such cases is so much involved in septic inflammation that nothing short of a hysterectomy would answer.

## CONCLUSIONS

1. In puerperal cases in which pus collects, evacuation by the vaginal route is the one of preference.

2. Failing to reach pus accumulations through the vagina, and in the absence of symptoms of thrombo-phlebitis, opening of the abdomen from above should not be lightly considered. Unless the symptoms are urgent, wait; and try if necessary a second time by the lower route.

3. If the septic foci are confined to the uterus, vaginal hysterectomy is the operation of choice; but,

4. With the exception of thrombo-phlebitis and septic uterus, major operations should if possible be postponed.

5. Avoid all unnecessary interference with adhesions in septic cases. Consider them sacred, they are nature's breastworks.

# PREPARATORY AND AFTER TREATMENT OF CŒLIOTOMY CASES[1]

By STEPHEN E. TRACY, M. D., Philadelphia, Pennsylvania
Gynaecologist to the Stetson Hospital, Philadelphia

No part of the surgeon's work offers a greater opportunity for careful consideration and the exercise of good judgment than the preparatory and after treatment of cœliotomy cases. Every patient about to undergo a serious operation should be in a well-equipped hospital where the surgeon can supervise the treatment, as careful attention to details in this work has much to do with the result of the operation and has a decided bearing upon the comfort of the patient. The expected good result of a well-executed operation may be lost by leaving the patient to the care of one not familiar with this special work, or by neglect of the surgeon to study carefully the patient both prior to and after the operation until the convalescence is well advanced.

Every patient about to undergo an operation should be put in the best possible condition as regards the general health regardless of the length of time it may take, providing the surgical lesion will permit of such a course. With the exception of emergency cases, the preparatory treatment of the average patient should begin two or three days before the operation. The lungs should be examined, and in case there is an acute cold or a bronchitis, the operation, if not imperative, should be postponed until the respiratory tract is in a healthy condition. The surgeon who neglects this precaution need not be surprised if such a patient develops a fatal pneumonia or an œdema of the lungs. The heart should be examined and if found weak such cardiac stimulants as strychnia and strophanthus, either singly or in combination, should be administered. An ordinary heart lesion with compensatory hypertrophy is no contraindication to the administration of an anæsthetic providing the muscle of the heart is not weak from degeneration.

The urine should be measured and examined both chemically and microscopically for at least two or three days. If the quantity of urine be small, or should it contain albumin and tube casts the patient should be encouraged to drink large quantities of water, should be put on liquid diet, and given appropriate treatment. The operation should not be undertaken until the kidneys are functionating normally. In case the renal disturbance is due to pressure from a neoplasm, the surgeon must use his judgment as to the time the operation should be performed. As a general rule diabetic patients should not be subjected to operation unless the etiological factor is to be relieved by the operation. An example of such a condition would be a chronic pancreatitis due to gall-stones or pressure from a neoplasm. I recall one patient upon whom I operated for a large ovarian cyst, where there was marked glycosuria, which cleared up promptly after operation.

The alimentary tract should receive careful attention and the treatment should begin with the mouth. Many patients, especially in the lower walks of life, pay little or no attention to the condition of the teeth and to the cleanliness of the mouth. Upon examination of such patients it is frequently found that one or many teeth are missing, the alignment irregular, and the points of contact imperfect. The teeth that remain are covered with a deposit of tartar and putrescent matter. Sometimes there is an abscess of a tooth with pus discharging into the mouth, and in many cases there are symptoms of a marked pyorrhœa alveolaris and the mouth is alive with infection.

In such patients it was my custom until recently to have the mouth swabbed with pure hydrogen dioxide three or four times a day, and rinsed many times a day with an alkaline antiseptic solution. In fact, every patient was instructed to use such a solution many times a day in order to diminish the amount of infection in the oral cavity. More recently, in patients whose teeth are in a bad condition and the mouths alive with infection I have employed as soon as the patients are admitted to the hospital the following technique: The teeth, the interstices, and the gum margins are painted with a solution of one of the non-irritating salts of silver and then sprayed with pure hydrogen dioxide under a pressure of about thirty pounds. The same surfaces are then painted with tincture of iodine and again sprayed with pure hydrogen dioxide under pressure, and this is followed by atomization with a pleasant antiseptic mouth wash. From then until the time of operation the mouths of all patients are cleansed many times a day with the antiseptic mouth wash. About half an hour before the patient goes to the anæsthetizing room, the nares and pharynx are sprayed with a solution of hydrogen dioxide and water one to three, to diminish the amount of infection

[1] Read before the Philadelphia Obstetrical Society, March 4, 1909.

on these surfaces. The mouth is then rinsed with equal parts of hydrogen dioxide and water, followed by the antiseptic mouth wash. In cases where the patients are confined to bed and not able to go to the compressed air apparatus the same technique is carried out with the exception that the atomization under pressure is done with the ordinary bulbous atomizer. In case the infection is severe, if possible, the operation is deferred until the condition of the mouth is improved.

When this important part of the preparatory treatment is neglected large quantities of micro-organisms are carried into the gastro-intestinal tract and there cause fermentation, with the production of gas, discomfort to the patient and anxiety to the surgeon. Last but not least, while the patient is inhaling the anæsthetic, the infection may be carried into the lungs and be followed by an inspiration pneumonia, a pleurisy, or an œdema of the lungs.

The gastro-intestinal tract should be thorougly emptied, and this is best accomplished by one or two doses of castor oil administered from forty-eight to twenty-four hours before operation. The oil empties the bowel, does not deplete the tissues of fluids, causes no intestinal irritation, and when the patient arrives at the operating table the bowels will either be collapsed or will contain but little gas. Give a patient calomel and sulphate or citrate of magnesia from forty-eight to twenty-four hours before operation, and she will be weak from many serous movements, the tissues will be depleted, the bowel will be irritated, and in the majority of cases the surgeon will be annoyed by the distended gut ballooning in the field of operation. In case of marked constipation or of impaction of the bowel, several days should be taken to prepare the gastro-intestinal tract. Several hours before operation the patient should be given an emema. The patient should be encouraged to drink freely of water, which furnishes fluids for the tissues, stimulates diuresis, and lessens the thirst after the operation. The diet should be liquid with little or no milk during the preparatory treatment. The pateint should be given an opportunity to rest the night preceding the operation. One who spends a wakeful night from many bowel movements is a better subject for the rest treatment than for an operation.

All patients not confined to bed should be given a daily bath in the tub, and a sponge bath in bed the morning of the operation. Patients confined to bed should be given a sponge bath daily.

A few hours before the operation the abdomen should be shaved, washed with soap and water, then with ether to dissolve any particles of fat, followed by a solution of corrosive sublimate and covered with a moist antiseptic dressing. The patient should be catheterized immediately before going to the anæsthetizing room. After the patient is placed on the operating table a rapid and satisfactory disinfection can be accomplished by painting the abdomen with Churchill's tincture of iodine and by washing with alcohol, seventy per cent. This disinfection should be made with the least possible wetting of the patient, blankets, covers, etc.

The most satisfactory anæsthetic in the majority of cases is ether, which should be administered, not by an inexperienced resident, but by a well, especially trained assistant. Ten or fifteen minutes before the anæsthetic is administered, a hypodermic injection of morphine sulphate and atropine sulphate is of value. This quiets the patient, the ether is taken more kindly, a smaller amount is required, and the collection ot mucus in the throat is prevented.

Care should be taken not to allow the arms of the patient to hang over the edge of the table. Neglect of this precaution even for a few minutes may be followed by a severe paralysis of the susculo-spiral nerve.

The postoperative treatment should begin when the patient is placed on the operating table. Much can be done to prevent shock by keeping the patient warm and dry during the operation. The operating table should be covered with blankets or a hot water cushion, and with the exception of the field of operation, the patient should be thoroughly protected. The custom of some surgeons to have large quantities of solution poured over the abdomen and then to have the patient lie on a cold table, or in a puddle of water, surrounded by cold, wet covers, is mentioned only to be condemned.

When the patient is returned to bed she should be thoroughly protected and kept warm by artificial heat, which at this time is the best of all stimulants. A patient usually tosses around the bed, throws the arms about and exposes the chest. To prevent taking cold and to lessen the risk of a pneumonia or an œdema of the lungs, it is my custom to have a cotton jacket applied in all cases as soon as the patient is returned to bed. In case a slight congestion or an œdema of the lungs follows operation the condition can usually be relieved by the use of dry cups, stimulants, and heat. In case pneumonia develops the usual treatment for such a condition should be carried out.

In nearly all operations there is a certain amount of shock. Should the condition be marked hypo-

dermoclysis of a litre of physiological salt solution should be given, to which may be added 30.0 to 60.0 cc. of whiskey. Strychnia, digitalis, camphorated oil, caffeine, or spartein should be given hypodermatically in such quantities as may be demanded and repeated as often as may be necessary. At times one or two hypodermic injections of adrenalin solution may be of value in bracing up the circulation, but should not be continued, as it has a tendency to produce petechial hæmorrhages and œdema of the lungs

It is seldom necessary to give an anodyne after an operation. When a hypodermic injection of morphine and atropine is given before the anæsthetic is started, the patient usually sleeps three or four hours after being returned to bed, and by that time the severe pain, as a rule, has subsided. Should the pain be severe a hypodermic injection of codeine phosphate 0.03 gm. will usually be sufficient. In neurotic patients a hypodermic injection of sterile water will frequently give as much relief and happiness as a grain of opium. Nervous patients can often be made comfortable by the administration of bromides by the bowel. Under no circumstances do I allow a patient to have a hypodermic injection of morphine after operation, as it masks symptoms, often causes nausea and vomiting, and ties up the bowels. I could never see the wisdom of giving a patient morphia or opium, and cathartics at the same time. The more gentle the manipulations, the less pulling on the tissues, the smaller the pedicles, the less pain will the patient suffer; the more skillful the operator, the less discomfort for the patient.

After reaction takes place nearly all patients complain of thirst and many, if given the opportunity, will eat the ice from the icebags and in some cases will even drink the water from hot water bags. After the patient is awake water may be given in small quantities and increased gradually. Ice should not be given, as it increases thirst and only adds to the discomfort of the patient. Much comfort is given by washing the mouth with a cold, alkaline antiseptic solution, and keeping it clean and sweet by the frequent use of such a solution continued throughout the convalescence. When the stomach is not retentive the thirst can be relieved by giving salt solution by the bowel.

As a rule, a patient does not vomit after recovering from the anæsthetic. In case vomiting does persist the stomach tube should be used early and as often as may be necessary. Medical treatment for postoperative vomiting is practically useless. At times a patient will state that a certain article of food or drink, such as a particular brand of beer or ginger ale, will settle the stomach. Unless the article would be absolutely harmful I believe it well to grant the request of the patient, as the result is often most pleasing. In case of acute dilatation of the stomach lavage should be carried out as soon as the diagnosis is made, and repeated as often as the stomach refills. It might also be well to place the patient in the Trendelenburg position. Vomiting due to renal insufficiency or to sepsis can be controlled only by treatment which will modify or relieve the exciting cause. After twenty-four hours the stomach is usually retentive and albumen water or broth may be given. The ingestion of milk is followed by fermentation with the production of gas and is not given until after the bowels have been moved thoroughly. After the bowels have been moved the diet should be increased to meet the demands of the appetite. One reason why so many patients are weak when ready to leave the bed is because they have not been given sufficient nourishment.

When the bowels have been moved thoroughly before operation there is no occasion to disturb the patient with cathartics for three or four days, and in many cases the bowels will move in this time without medication. Cathartics given a few hours after operation not infrequently cause nausea, vomiting, and distension of the bowels with gas, which makes the patient uncomfortable and restless, and gives the surgeon just cause to worry. If the bowels have not moved at the end of three or four days this is easily accomplished by a dose of castor oil, which acts promptly and completes its work in a few hours. By giving a suppository of asafetida every three or four hours after operation the patient will seldom be troubled with gas. Should the bowels become distended an enema of milk of asafetida, or alum 30 gms. in a litre of warm water will usually relieve the condition. At times eserine salicylate hypodermatically every three or four hours will stimulate peristalsis and aid in the expulsion of gas. The surgeon should always be on the alert for postoperative ileus, make the diagnosis early, and reopen the abdomen at once while the patient is in good condition. The surgeon who says he never sees a case of postoperative ileus is either a poor diagnostician or does but little abdominal surgery. Gynecologists of course will meet with this condition much less frequently than the general surgeon.

When the abdomen has been closed without drainage the patient should be allowed to assume the position which is most comfortable. There is but little danger of an incision which has been

properly sutured reopening from the patient moving about in bed. The question arises, when should the patient be allowed to leave the bed? There should be no fixed rule about this matter. The question should be settled by the condition of the patient and the nature of the operation. I doubt if it be wise or if anything be gained by allowing a patient out of bed in less than one week. On the other hand it is not necessary to keep the average patient in bed longer than one or two weeks. Patients suffering from neurasthenia, and those debilitated by disease derive much benefit by remaining in bed several weeks. Some surgeons claim that by allowing a patient to move about freely and to leave the bed early phlebitis and embolism will be avoided. Such an expression sounds well, but I doubt if there be any good ground for such a teaching. We all know that a patient who remains in bed several weeks while taking the rest cure seldom develops a phlebitis (Baldy). A patient who develops a phlebitis should remain in bed at absolute rest until all swelling and inflammation have subsided.

The incision, as a rule, should not be inspected nor disturbed for at least a week, at which time if asepsis has been perfect and the technique proper, primary union should have taken place. The incision is then wiped off with alcohol and a light dressing for protection is applied. Occasionally, the chromic gut, which is usually used to close the fascia, will cause a certain amount of irritation and there will be a collection of serum in the subcutaneous tissues. Such wounds should be opened by a puncture, only sufficiently large to allow the serum to escape, and covered with gauze moist with alcohol. To open freely and cauterize such an incision simply converts what would be a primary union into a union by granulation and suppuration. Necrosis in the superficial wound is due, usually, either to an error in asepsis or to the use of too many sutures tied too tightly.

The use of the abdominal bandage after the patient leaves the hospital, except for a patient with a greatly relaxed or pendulous abdomen, has been abandoned as a useless and uncomfortable appliance.

The urine in all cases should be measured and examined after operation in order to determine the functional activity of the kidneys. The more thoroughly the system is relieved of toxines, the more liquids taken a few days before operation, and the smaller the quantity of anæsthetic used, the less likely is there to be disturbances of the renal function. In case of renal insufficiency following operation the condition can usually be relieved by placing hot applications to the region of the kidneys, by giving physiological salt solution by the bowel, under the skin, or both, and by full doses of spartein sulphate and caffeine hypodermatically every four to six hours.

When the patient cannot urinate she should be catheterized every six or eight hours. In case it is necessary to use the catheter, every precaution should be taken to prevent an infection of the bladder and the resulting cystitis. While it is impossible to catheterize a patient many times without the bladder becoming infected, it may be prevented in a large percentage of cases by irrigating the bladder with a solution of boric acid or some mild antiseptic solution, such as oxycyanide of mercury, after each catheterization.

Attention should be given to the surface of the body and the skin should be kept active by a sponge bath daily, followed by a rub with dilute alcohol. The back and other points of pressure should be kept dry and bathed with alcohol. The Scultetus bandage should be changed as soon as it becomes damp or soiled.

In cases where peritonitis is present at time of operation or follows an operation, the patient should be placed in the Fowler position, and proctoclysis of physiological salt solution, as recommended by Murphy, should be given. When nausea and vomiting are present in such cases, not anything should be given by the mouth, and such stimulants as may be demanded should be given hypodermatically. Since Murphy described his treatment the mortality in cases of diffuse peritonitis has been greatly reduced. Murphy reported recently forty-eight cases of diffuse peritonitis with but two deaths; one due to a double pneumonia, and the other to a mechanical ileus.

The after care of cœliotomy cases should not be carried out along any fixed line, and the same treatment should not be applied to all cases. Each patient should be visited daily by the surgeon himself, watched carefully, and treated according to the conditions present. The less disturbance, the less medication, the more nourishment, the more freedom, the shorter the time confined to bed, within reasonable limits, the more contented will be the patient and the more rapid will be the convalescence.

# TRANSACTIONS OF SOCIETIES

## CHICAGO SURGICAL SOCIETY

A Regular Meeting was Held March 5, 1909, with the President Dr. A. E. Halstead, in the Chair

### ENTEROLITHS AS A CAUSE OF INTESTINAL OBSTRUCTION

### ECHINOCOCCUS CYST OF THE KIDNEY

By D. W. GRAHAM, M. D.

ENTEROLITHS AS A CAUSE OF INTESTINAL OBSTRUCTION

Dr. D. W. Graham: This specimen which I show was recently taken from the jejunum of a woman 69 years of age. It is oblong in shape and tapers at what was the upper end as it lay in the intestine. It originally measured something over $2\frac{1}{2}$ inches in length, and $1\frac{3}{4}$ inches in diameter. The small end is quite brittle and crumbles easily, indicating, I think recent formation. It has been sawed in two so as to show the structure. The nucleus is plainly seen, is $\frac{1}{3}$ of an inch in diameter, is situated $\frac{3}{4}$ of the long diameter from the upper or smaller end, and shows on analysis to be a gall-stone. Around this are more or less concentric layers of growth consisting of organic matter, debris from the intestinal secretions, and some salts — chiefly phosphates. The mass could easily be mistaken for a large gall-stone, if judged only by its shape and gross appearance, and it is reasonable to infer that the specimens found under similar circumstances, and reported as large gall-stones, have been of the same character as this one — that is, an enterolith with a gall-stone nucleus.

The clinical picture of this patient was that of acute obstruction high up in the alimentary canal; frequent and persistent vomiting; no result whatever from cathartics repeatedly given except to increase the vomiting; no febrile symptoms, no tympanites, no dilation of the stomach, no fœcal vomiting. There had been a sudden onset of these symptoms five or six days before. There was a fairly definite history of a number of attacks of gall-stone disease two years previously. Since that time the patient had gradually lost flesh and strength, apparently from impaired digestion, though the appetite remained good, and she had also suffered a good deal during these two years from pain in the upper abdomen, often a dull aching, sometimes colicky, and occasionally severely paroxysmal. There never had been pronounced jaundice at any time. At the time of the operation, besides the absence of tympanites, already mentioned, no swelling could be detected through the abdominal wall anywhere, and on palpation there was not much pain elicited at any point, and at no one point more than another, and only such soreness as might be attributed to the prolonged vomiting.

Through a median incision above the umbilicus I explored for the nature and the location of the obstruction. About the gall-bladder, pylorus and duodenum there were many old and dense adhesions. One broad free band extended across the colon and was adherent to a loop of the small intestine. This was tied off, but did not seem to be a factor in causing the obstruction. The pylorus and stomach seemed to be normal. The loops of small intestine were all equally collapsed. A thorough search for trouble was made in all parts of the abdomen and pelvis, but nothing suspicious was found. It then seemed certain that the seat of the obstruction was in the duodenum, due to the old adhesions. A posterior gastrojejunostomy was decided upon and quickly done. I was not fully satisfied, however, that I had found adequate cause for the obstruction. So I began to follow the jejunum downwards, and only two or three feet beyond the loop attached to the stomach I encountered the enterolith firmly grasped by the bowel walls. It was easily reached by an incision, and the wound was closed in the usual way. There was no evidence of necrosis or danger to the interstitial wall caused by the stone, such as has sometimes been found in similar cases. The patient died on the fifth day following, apparently

from exhaustion, though there were symptoms of arterial thrombus affecting both lower extremities. The vomiting ceased at once after the operation, and did not reappear. There was no tympanites at any time.

Several interesting questions arise in relation to this case pertianing to the stone and its location. It is incompatible with the history that it could have grown to its present size in the jejunum, and where it is possible for a stone of this size to ulcerate through the gall-bladder and an adherent loop of the intestine and be found in the lumen of the latter, the history, the composition of the stone and the operative findings disprove this theory. My theory of the sequence of events is this: First, cholecystitis, recurring at intervals, a stone eventually passing through the cystic duct and making a quick transit through the common duct into the duodenum. Second, that the stone lodged in the duodenum for about two years and there grew as an enterolith to the present size. Third, that the onset of the obstructive symptoms marked the passage of the enterolith from the duodenum into the jejunum. This view is sustained by recalling the anatomy of this part of the bowel. The transverse middle portion of the duodenum is of large diameter and somewhat sacculated and sagging, whereas its terminal portion is narrower and ascending. Also at its junction with the jejunum in front of the second lumbar vertebra there is more or less of an acute flexion in the course of the bowel. Indeed, this large dependent portion of the duodenum would seem to be the only possible point in the upper bowel where a stone could rest any length of time and grow to any size.

It is proper to state in this connection that considerable of the data in the history of this case was obtained subsequent to the operation, due partly to the fact that there had been several changes of attending physicians since the first illness of the patient.

I shall not enter into the subject of differential diagnosis except to say that in high acute obstruction, when there is a history of antecedent gall-stone disease, one ought always to suspect enterolith as the cause of the obstruction, in the absence of other obvious cause, and this, whether before or during an exploration. There is comparatively little recent literature on the subject of enteroliths. This would indicate that they are relatively less frequent than formerly, and also tend to prove that the predominating factor in the formation of these intestinal bodies, whether called enteroliths, concretions, or what not, is antecedent gall-stone disease, for modern surgical treatment largely eliminates this element.

### ECHINOCOCCUS CYST OF THE KIDNEY

The next case I report is one of echinococcus cyst of the kidney. I have never seen but this one case, nor have I ever heard of any in the practice of my associates. It is exceedingly rare, and there are very few such cases in the literature; yet the books refer to hydatids of the kidney as being third in the order of organs involved in hydatid disease, the liver being first and the lungs second.

This patient could not talk English and a satisfactory previous history could not be obtained. She had been confined two weeks before I saw her, and the labor had been normal, but shortly after confinement she had a high fever, which was thought to be puerperal. Examination revealed a large fluctuating mass on the right side, extending from the hypochondrium down to the crest of the ilium, filling one half of the abdomen. Some white bodies were shown me as having passed with the urine. They proved to be small hydatid cysts, and gave a clew as to the nature of the abdominal mass. They were as large as the end of the little finger. She passed more of them, some of them being broken, after entering the hospital. It seemed incredible to me that such bodies could pass through the ureter, yet they did so pass, and I find the same phenomenon referred to by a few writers. As all the symptoms, both local and general, indicated suppuration, I incised the mass in the loin, and a great number of daughter cysts came out with the free flow of pus. No effort was made to remove the cyst.

Another feature was that the anterior wall of the large sac was calcified, so that it crackled on pressure.

Nothing more than free drainage was attempted. This, however, made but little improvement in the patient's already profoundly septic condition, and she died ten days later.

According to the scant literature on the subject, these cysts of the kidney are prone to suppurate, and nearly all prove fatal.

### DISCUSSION

Dr. D. A. K. Steele: I had an almost identical experience to the one mentioned by Dr. Graham, some fourteen years ago. The patient, a lady, had intermittent attacks of intestinal obstruction which lasted for two or three days, then followed by vomiting. It was a case of acute intestinal obstruction in which I opened the abdomen, and found a concretion as large as a hen's egg, a so-called enterolith. It was formed in the same way with these concentric additions to the central stone or gall-stone. This lay like a ball-valve at

the ileo-cecal valve or junction where the ileum passes into the cecum, and I think the narrow portion of the ileum there caused the obstruction to the passage of the enterolith. It was readily removed through a short incision. The woman had symptoms of obstruction two or three days before I saw her. This is the only typical case that has come inder my observation. Rarely do we find a typical enterolith such as this specimen or the one I saw some years ago. I quite agree with Dr. Graham that they are not as common now as they formerly were.

## THE SURGICAL CONSIDERATION OF GOITER

By D. A. K. STEELE, M. D.

The surgical consideration of goiter forcibly reminds us of the tremendous advances made in the operative treatment of this affection in the last half century, a mortality of more than 40 per cent having been reduced to less than 5 per cent, and in the hands of expert single operators to less than one-half of 1 per cent (Kocher). The combined factors of more accurate anatomical knowledge, improved surgical technique, asepsis and anæsthesia have contributed to this result.

Histologically, goiters may be described as:

*a*. Simple colloid hypertrophy.

*b*. Adenoma.

*c*. Adenoma with cystic degeneration.

*d*. Exophthalmic.

Simple hypertrophies occurring about the age of puberty in young girls the so-called struma, ante-menstrualis and the hypertrophic occurring during the latter months of pregnancy are probably physiological activities of the gland and usually disappear wholly or in part in the course of time, or under medical organotherapy and hygiene treatment and should not receive surgical consideration.

The adenomas, the cystic degenerations and the exophthalmic goiters which have failed to show permanent improvement under medical and organotherapy should be subjected to surgical treatment. Also all goiters undergoing cancer-sarcomatous or tuberculous infection should be promptly removed by surgical operation.

Partial excision, enucleation and ligation of the thyroid arteries are the three surgical operations to be considered, each having an appropriate place in individual cases. Treatment by injection, puncture, or incision and drainage, has become practically obsolete.

Total removal of the gland is no longer done except in case of carcinoma, as it was followed by myxœdema in 70 per cent of cases; removal or injury of the parathyroids should be avoided on account of the danger of tetany developing; by preserving the posterior capsule and leaving one-fifth of the gland we are safe from these dangers.

Care to avoid injury of the recurrent laryngeal nerve when tying the inferior thyroid artery is necessary, and led Kocher to use cocaine anæsthesia. Deaths occasionally occur from shock, hæmorrhage, pneumonia, infection, myxœdema and tetany, in spite of the greatest care on the part of the surgeon. In cases of exophthalmic goiter, with the usual symptoms of enlargement, lochycardia, exophthalmus, muscular tremor, thirst and general nervousness, whether vascular, hypertrophic or hyperthyroidism on existing goiter, surgeons are pretty unifomly of the opinion that medical and organotherapy should precede a partial thyroidectomy which finds a cure in more than one half of these cases, marked improvement in 25 per cent more, and a relapse or partial failure in the remaining 25 per cent.

Psychic phenomena causes deaths in these cases, sometimes apparently through fear. Crile seeks to avoid this by preparing the patient for an operation at a different time than the one really chosen for the operation.

### TECHNIQUE

The field of operation is prepared in the usual way. The patient is placed in the reverse Trendelenberg position, i. e., with the head high and a roll under the neck. Ether by the drop method is given where a general anæsthetic is required, or sometimes rectal anæsthesia is resorted to, or a one-half of one per cent cocaine is used locally along the line of proposed incision by the infiltration method. Either the sigmoid or collar incision is used as preferred by the surgeon.

The incision is carried across the center of the tumor through the skin and platysma muscle, the flap being raised to freely expose the sternothyroid and thyroid, which may be displaced laterally or divided high up and displaced upward and downward to be subsequently sutured.

The tumor can now be deliverd toward the median line, the capsule split longitudinally, the superior thyroid artery ligated, the lower pole deliverd and the inferior thyroid ligated close to the tumor and avoiding the nerve. Kocher at this

stage always has the patient speak while he is tying the vessel so as to be sure that he does not include the recurrent laryngeal nerve. This is one advantage of local anæsthesia.

The lateral veins are clamped and cut between ligatures, many forceps being required. I have had more than forty on one patient.

In colloid tumors one side and the isthmus is resected. The posterior capsule is pushed off with gauze and preserved. Care is taken to avoid crushing or bruising the stump of gland left. Drainage, capillary or glass, is made at the inferior angle or through a buttonhole where the transverse incision is used, for 48 hours. Drainage is always required in exophthalmic cases. Where there is much shock continuous proctoclysis with warm saline solution may be used for 48 hours.

Compared with other major operation, radical operation for goiter gives very favorable results. The immediate relief from urgent symptoms, the prompt recovery and the low mortality will insure a permanent place for thyroidectomy, unless the investigations now going on in the Loomis and other laboratories and in hospitals as to the functions and pathological and physiological alteration of this gland may result in a better understanding of the question of organotheropy. Serum treatment and the whole subject myxœdema, hyperthyroidism and so forth, so that we may be able to induce and control these morbid alterations of the gland in a more definite way, as our knowledge increases, and eventually cure our goiter patients without resorting to surgery.

Dr. Dean Lewis presented a paper on "Pathology of Goiter," which was illustrated with stereopticon slides.

DISCUSSION

Dr. M. L. Harris: In considering the surgical aspects of goiter, I shall say something in regard to the technique of the operation. Operations on the thyroid may be as simple as any operation we have to do, or they may be as difficult. I know of nothing which is more difficult than the removal of some large thyroids which we occasionally see, that project into the upper part of the chest cavity; for instance, extending a way down behind the sternum, where we come in contact with the large veins, and where the numerous veins which are presentive, these large thyroids are so difficult to reach. The hæmorrhage in some of these cases is most alarming. I know of no hæmorrhage which is all of the function of the gland on either side. We so alarming and so difficult to control. These veins are extremely fragile, and often in attempting to clamp them with artery forceps they are apt to tear and the hæmorrhage may be greater every time we try to put forceps on them.

I would divide the cases into two classes, and I think the method of procedure is quite different. First, into those of ordinary goiters, such as the adenomas and colloid goiters and all varieties of goiter except exophthalmic goiter. Of course, that is placed in a class by itself. In the colloid goiters my method is enucleation. In these cases we can enucleate the diseased part of the gland and leave the healthy part, and that I think we should try to do. In practically all of these cases the tendency is toward hypothyroidism, and we should save all of the function of the gland that we can; therefore, after reaching the capsule and ligating the majority of the vessels, I split the capsule and begin to enucleate the adenomas, which are easily enucleable, and the same with colloid goiters, and cystic goiters. These cases are usually bilateral and we have to operate on both lobes. By this enucleation method we are able to save all of the function of the gland on either side. We can enucleate any number of adenomas or any number of colloid cysts. There may be two or three, or there may be any number of them, but they are practically all easily enucleable, and there is little hæmorrhage following the enucleation if you get in the right layers. If you enucleate and tear the capsule, and therefore the vessels, the hæmorrhage will be very alarming, but if you get below this layer or into the layer between the gland and adenoma you can then enucleate without hæmorrhage.

In the exophthalmic variety we want to avoid the gland and never get into it. Therefore we separate outside of the gland until we get to the posterior part: we avoid getting into the gland because we wish to avoid scattering the gland material, and thus prevent its absorption and the production of hyperthyroidism which causes death in these patients after these operations. In the exophthalmic variety, after exposing the gland and getting down to the capsule, I proceed to ligate the vessels. Usually we find the greatest difficulty in dealing with the superior thyroid. In pulling down the upper corner of the lobe we stretch and draw on the superior thyroid vessels, and when the lobe projects upward and well backward we find, when we have drawn it down, that we have put the vessels on considerable tension, and there is danger of the vessel excaping from the ligature or clamp, with excessive hæmorrhage. After the superior vessels are ligated, it loosens up the gland and allows it to be displaced forward, and then we proceed to ligate the inferior artery. I never ligate this vessel in continuity of the main

artery, but it should always be ligated inside of the capsule after the vessel has subdivided into its branches. There are two reasons for this: first, by so doing we always escape the recurrent laryngeal nerve; and, second, by ligating it inside the capsule, after it is broken up into its branches, we avoid cutting off the circulation to the parathyroids. The parathyroids are largely supplied by the branches of the inferior thyroid. We save considerable of the posterior portion of the gland at this point. Then we ligate the isthmus in sections, cut it off, and remove the lobe. With me it has been a question of how much of the gland to remove. I have never been able to determine just how much of the gland we should remove. We remove a certain portion of the gland, but if we do not remove quite enough the patient will not be cured. That is why the ordinary statistics show from fifty to sixty per cent cures, and seventy-five to eighty per cent improvement, and the balance unimproved. This simply means that we have not removed enough of the gland in the uncured cases. If we take the twenty-five per cent partial improvement, and do a second operation and remove more of the gland, we can cure them. I have in several instances failed to get the results which I anticipated by reason of not removing enough of the gland. These patients had little improvement, and in some of them the improvement has not been of any material advantage. Then we have to reoperate and remove more of the gland. It is a question with me to determine just how much of the gland I should remove. I know no way of telling, because the amount of thyroidism we find is entirely independent of the size of the gland. We may have excessive hyperthyroidism and a very small gland, and we can have a large gland and little hyperthyroidism, so that the size of the gland is no indication at all of its function.

Dr. Steele said he always used drainage. I never use drainage in these cases. In the ordinary goiters, after enucleation, in place of draining the cavity to get rid of any oozing that may take place, I take catgut and sew the cavity up. After removing part of the gland, or half of it, in the exophthalmic variety, I sew over the isthmus that is left, or where we have divided it and the posterior capsule and posterior part of the giand which we leave, sewing these all up with catgut so that no space is left. Latterly I have avoided the use of drainage in any of these cases. It is unnecessary to disturb the wound by looking at it, and the longitudinal wire suture is allowed to remain for ten days.

Dr. Steele called our attention to Dr. Crile's method in preparing these patients for operation. It is doubtless of considerable value to prepare a patient with the exophthalmic variety of goiter by rest in bed. I have all of my patients take rest in bed several days before operating on them. I keep them on a meat-free diet, giving them milk and cereals, which I think is very important. If they are excessively toxic by reason of hyperthyroidism, a meat diet disturbs the stomach and bowels, producing diarrhœa, which will be materially benefited by the milk and cereal diet and this diet, with the rest in bed, will prepare the patients and quiet them down. The pulse will come down, so that they are less likely to have hyperthyroidism following operation. Patients who die after operation die in from thirty-six to forty-eight hours. Within twenty-four hours the pulse is accelerated, and in thirty-six hours it is almost out of sight, and, if they are going to die, they die within thirty-six to forty-eight hours. Dr. Crile's method, as Dr. Steele said, is to overcome the fear of these patients, who are extremely nervous and therefore easily excited. Dr. Crile puts them in bed, keeps them on a certain diet, and every day the nurse administers to these patients something which they inhale and believe is one of the means of treatment, and this is kept up every day, so that the patients, when they are about to be operated on, have little or no fear of the operation. Dr. Crile thinks this is of considerable value in fooling the patient along in that way for a week or ten days before operating. I do not know of how much value it is.

After operation, in my experience, the first symptom of improvement is noticed in the heart. The pulse begins to come down after forty-eight hours, and within a few days or a week it reaches pretty nearly normal if you have removed sufficient of the gland. The condition of the eyes is the last symptom to disappear. I have seen patients in whom all of the symptoms disappeared, that is, the heart symptoms and the tremor, but the protrusion of the eyes is still present a considerable time after the operation. The patients feel perfectly well with the exception of the bulging eyes. Again, in some of the other cases, the symptom of bulging of the eyes disappears within a few weeks so that it is scarcely noticeable, but it has been the last symptom to subside in my experience.

Dr. Daniel N. Eisendrath: There was one point Dr. Steele brought out in his paper which I think cannot be too strongly emphasized, and that is also mentioned by Dr. Harris, namely, ligating the superior thyroid artery. I had occasion not long ago to see Dr. Mayo operate on a number of these cases, and this point was forcibly impressed

upon me. Supposing this (indicating on blackboard) should represent the line of the first incision, and this should represent the sternothyroid and sternothyroid muscles, he makes this buttonhole at the upper angle of the incision through these muscles, allowing them to retract thoroughly, cuts the largest so as to expose the superior thyroid artery, and in that way the arteries can be secured perfectly and the ligature applied without any danger of its slipping off afterward.

Another point of value which was brought out by Dr. Mayo at the last meeting of the Western Surgical and Gynecological Association was this: He stated that it was his misfortune in one case to have had a serious hæmorrhage from the slipping of the ligature applied to the superior thyroid artery, due to the fact that he had included a part of the omohyoid muscle in his ligature. I have had occasion to see that since then at an operation and to notice the proximity of the omohyoid and superior thyroid artery. In his case, on account of the patient returning to bed and the contraction of the omohyoid muscle, the ligature on the superior thyroid artery slipped off and the patient almost had a fatal hæmorrhage. He takes particular pains, after making this buttonhole, to lift away the omohyoid and apply the ligature independently of it.

The second point I wish to refer to is the fact that we are constantly confronted, especially in large goiters of long standing, with a trachea which is pathological. We have not a normal trachea to deal with in such cases. It is pushed over to one side. In either case it is pushed backward, or deeper, so that a considerable part of the rings of the trachea may be atrophied, and not infrequently there is asphyxiation following the removal of large goiters. This is a point we cannot emphasize too much.

Dr. Harris referred to the danger of operating on retrosternal goiters. That has been my experience. They are the most difficult of all goiters to try and pull out and enucleate; and also, we have not only hæmorrhage, but displacement of the trachea, which is a very serious matter.

I think the majority of surgeons in this country have come to the idea of trying to operate on these cases, so far as I know, under general anæsthesia in preference to local anæsthesia, and in this I believe we have great many advantages. We can have the fullest exposure of the neck, enabling us to do the work more thoroughly and easily.

There is one point which should be more fully discussed, and especially by medical men, and that is, where we shall draw the line in operating on cases of exophthalmic goiter. I think surgeons make a mistake in saying that every patient with exophthalmic goiter is a subject for surgical interference. That is going too far. I believe a very large proportion of these patients can be vastly improved, and practically the symptoms remain latent, if not altogether disappear, without any manifest disturbance, by medical treatment, and I believe in a discussion of this kind we ought to hear from our medical brethren as well as surgeons. It is a great mistake to operate on patients with a pulse of 120 to 130. I think these patients ought to be subjected to a longer period of rest than two or three days, say a period of two to three months, until the pulse comes down, until they are safe, and until they can stand what little spilling of the thyroid secretion may occur during the operation.

Dr. D. W. Graham: In regard to local anæsthesia in goiter operations, I understand that Kocher recommends it chiefly as a means of avoiding injury to the recurrent laryngeal nerve. I have never operated on a case of goiter under local anæsthesia, and feel averse to trying it. I know I can do better, quicker and safer work under general anæsthesia. We can hardly anæsthetize the operative field of a large goiter with less than a grain of cocaine. Even half a grain of cocaine will cause serious intoxication and a fatal result more frequently than will a general anæsthetic. That is my experience and observation with cocaine. The records will show that the ratio of deaths from cocaine is greater than from any general anæsthetic, as a general proposition. If it is claimed that the moral effect of using very weak solutions of cocaine and the partial local anæsthesia thus induced are quite adequate in many cases, the same and more can be said in favor of an incomplete general anæsthesia when a complete anæsthesia, for any reason, is not advisable.

I have found the greatest trouble with the small goiters. I am never much concerned about accidents and complications in large goiter, but I am in small ones that do not stand out much. They are always larger and deeper than they look to be. I prefer any time to tackle one as big as a man's head rather than one the size of a goose egg.

In regard to drainage, I think Dr. Steele's position is more rational than that of Dr. Harris, that however thoroughly the deep structures are sewed and coapted with catgut there is bound to be some capillary and venous hæmorrhage after closing these extensive and vascular wounds. It is true in many cases the amount is not sufficient to do any harm. Nevertheless, I prefer to use a small

tubular drainage at the lower angle, and remove it at the end of say twenty-four or forty-eight hours, as routine practice.

Regarding the isthmus, I do not find it necessary to tie it off in sections as I used to do. Cut it through at once, and there will be only a few small bleeding points, which can be tied separately.

DR. STEELE (closing the discussion): There is very little I can add to what I have already said in the outline I gave of the surgical treatment, except to call attention to the point made by Dr. Eisendrath, and that is, in all cases of exophthalmic goiter that fail to show continued improvement under medical and other treatment, a partial thyroidectomy should be done. I think the rest treatment is very important. I have not tried the rest treatment along the line advocated by Dr. Crile; but by rest in bed, getting the patient in the best possible condition for days or weeks, we are likely to lessen the mortality.

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# PROCEEDINGS OF THE PITTSBURG ACADEMY OF MEDICINE, FEBRUARY, 9, 1909

PRESIDENT F. F. SIMPSON IN THE CHAIR. THE SYMPOSIUM ON THE "THYROID GLAND" WAS PARTICIPATED IN BY DR. J. P. MCKELVY, PITTSBURGH; DR. LOUIS WILSON AND DR. CHARLES H. MAYO OF ROCHESTER, AND DR. ALEXIS CARREL OF NEW YORK.

The papers appear elsewhere in this issue. The discussion follows.

## DISCUSSION OF THYROID PAPERS

DR. LICHTY: The symposium is so evenly balanced that I really think it is almost a sacrilege to try and add anything to it or to suggest anything. In a symposium of this kind one who discusses it will either have to sit as a judge and decide upon the matter which has been given, or will have to give further evidence. I am sure it is not yet time to sit as a judge upon this question which seems just to have been opened, and certainly has been opened to us more fully this evening than ever before. These papers are complete, and all we can do is to give further evidence, be it medical or surgical.

The one point in the symposium, which impressed me very much and which has been impressed upon my mind for the past four or five years, is the change of the simple goiter into an exophthalmic goiter. I have had in my practice in the last ten years some seventy-four cases of exophthalmic goiter, and among these seventy-four cases I have noticed occasionally a case which I had diagnosed as simple goiter gradually developing into exophthalmus. I noticed this particularly at the menopause. I have one beautiful case now, which has demonstrated that this can occur, and which was apparently cured by the serum treatment, or probably cured by time; I do not know which. Then again I have seen this occur where there was a simple goiter of considerable size and severe strain coming upon the individual, the symptoms of exophthalmus appeared to an alarming degree and then again, with the proper treatment, went back to the simple goiter. I mentioned this to a group of men in this city a year or so ago, and thought it was original, but find that it had been observed by others, and one is always glad to have his experience confirmed, so that I am glad this point was emphasized this evening and I believe it is of great importance.

As I listened to this symposium it seemed to me as medical men, as internists, we will have to do this one thing; simply keep these patients alive, keep them comfortable until they go into the condition of hypothyroidism, and then ask the surgeon to transplant as much thyroid gland as is necessary to continue a comfortable existence. Or, if that is not necessary, to remove the deformnity.

From the paper of Dr. McKelvy we have been impressed by the relation of the thyroid to the different organs, and the fact that it is absolutely dangerous to tread upon this ground without a full knowledge of what we have before us. I have seen it quite frequently in cases of enlarged thyroid gland and protruding eyes where the patients have taken tablets of thyroid extract and were gradually getting worse. The only way we can do is to study the patient and the material which is needed in the way of extract or serum. I am ashamed to say that I have never had a case of goiter operated upon. The only reason for not having them operated upon is that the theories and treatments have changed so rapidly in the last ten years that by the time I thought the patient was ready for an operation a new treatment or new serum was introduced and I felt it only right to try it. I am glad

to say that it has not been to the detriment of my patients, because of the seventy-four cases, so far as I know, only three have died. Two of these were acute cases which started in immed ately after a nervous shock or strain, and the disease went right on to death. One case died of tuberculosis, so that the mortality given by one of the readers, of four per cent makes me feel that, as medical men, we are not so far behind in our mortality. Of course, a medical man must look further than simply to preserving the life of his patients. Of the other patients who are living I cannot tell you how many are suffering and are prevented from carrying out their daily vocation, but I know that they are living and that is *one* great object in the physician's work. I believe that a surgeon is probably more prone to base his results or his statistics upon the simple fact that the patient is alive.

The patients whom I have treated recently I have given the serum. Of the six thus treated, two are perfectly well. One case was acute and is perfectly well. The other was a chronic case of goiter which became an exophthalmic and recovered. Two of the other cases are well enough to teach school and seem to be comfortable, and one is under treatment and seems to be in good health. The sixth case, on account of living some distance from the city, has passed out of my care. The treatments employed previously were such as rest treatment, bromide of quinine, thyreoidectin and various other agents. The serum treatment has given more definite result than any other. I think we can look hopefully upon the promising work which has been done in this direction within the past year by Drs. Beebe and Rogers.

The statistics of results given by Dr. Mayo to-night show that in the hands of a competent surgeon those patients who do not get well by medical treatment can be safely turned over to the surgeon with an assurance that the results will be satisfactory.

DR. LITCHFIELD: I simply wish to add a few words, first of my appreciation of the papers which have been read, and second to support what Doctor Litchty has said about serum. I have been following the development of this treatment with a great deal of interest and I have the most intense admiration for the work Dr. Beebe has been doing in New York. There are certain points to be remembered in regard to this serum treatment. You all know of the records that have been published. Several hundred cases have been treated, not only by the doctors in New York, but by country practitioners and city practitioners all over the country, and with very good results. There are some cases so situated, geographically or financially, that they cannot receive skilled surgical treatment, as it is only the exceptional surgeon that is competent to cope with a problem so difficult and so delicate as this.

Furthermore, in comparing the serum treatment and the surgical treatment, it seems to me that the serum treatment is the ideal treatment, providing it fulfils the promises given. In the serum treatment the amount of serum can be so proportioned in the repeated doses that we can get just the amount of cytolitic or antitoxic action which is necessary, while in the surgical treatment this delicate problem of how much to remove must be decided on the spot once and for all, and if two much is removed it cannot well be replaced, and a condition of hypothyroidism follows the operation.

I got up to report a personal communication from Dr. Beebe regarding a certain class of cases which Dr. Mayo has already referred to as non-surgical cases. I refer to the acute toxic cases with a high temperature, delirium, dilated hearts and œdema, which often go down very rapidly and frequently terminate fatally. Dr. Beebe writes me this week that he has, within the past six months, had ten such cases treated by the serum and all have recovered or are markedly improved, and that four of them are back at work. Such work as this of Dr. Beebe's must be recognized in any discussion of these cases. He had been doing some very excellent work also in determining by bio-chemical tests where the hyperthyroidism ceases or fades into hypothyroidism. This is the most delicate problem relating to the thyroid, for on its solution depends the adoption of one or the other of two methods of treatment, which are diametrically opposed to each other. When such a case comes under observation it should be treated with serum for hyperthyroidism or with an especially prepared thyroid extract to remedy the hypothyroidism.

DR. OTTO C. GAUB: This subject of hyperthyroidism has been presented to us this evening in a masterly series of papers. From the facts presented we are led to believe that every thyroid possess potentially those factors which, when activated, lead to the symptoms of hyperthyroidism. The microscopic picture records the life history of the disease. From the various types of operations and the differing modes of medical treatment formerly in practice, it is apparent that clinicians were seeking in each case for the source of the particular activating substance or hormone and this source corresponded with the personal opinion or theory of the clinician, thus some portion of the

nervous system, the intestinal tract or the ductless glands are looked upon as the originators of these hormones.

This line of research is of value, for if the source of the activating substance is determined, efforts to correct the faulty metabolism, if successful, would be ideal treatment. At the present time, however, we are unable to isolate any special hormone and must consider these activating substances as of various origins, but each one bringing about as an end result that increase in the parenchyma of the thyroid gland so beautifully shown here this evening, the ebb and flow of these hormones being registered in the microscopic pathology of the thyroid.

The medical treatment of hyperthyroidism is directed toward the curtailment of activating substances by gerneal hygienic measures, certain milks, serums, etc. It has been stated this evening, in a report of cases treated medically, that the mortality is no greater than the operative mortality. But what is the condition of those patients surviving? My experience is they wish to enjoy life and not merely exist, and from the published reports of the end results following operation, in the light of our present knowledge, surgery, although it may be crude, offers these unfortunates, the one way such cure or improvement may be brought about. The selection of the patient, the time and type of operation are the criteria that make for success.

Dr. J. D. Singley: In no class of cases is the surgeon called upon to exercise greater judgment and discrimination than in the treatment of exophthalmic goiter, or better, thyrotoxicosis. The proper case for operation, the proper operation, the preparation of the patient, and the proper time for operation,— these are matters demanding the greatest consideration and attention.

We know something of the chemistry and function of the thyroid and parathyroid glands and the important part they play in the metabolism of the body; but much remains to be elucidated. In the light of our present knowledge the essential fact to be borne in mind is that the intoxication of the body is carried on through the thyroid gland, as pointed out by Kocher.

It is claimed that the diagnosis of exophthalmic goiter can be made by the blood examination alone, but I do not believe that a diagnosis should be made in this way. Rather should the clinical smyptoms, together with the blood picture, taken as a whole, form the evidence upon which a diagnosis is based. Diagnosis should be made early. To permit a case to develop the wide-spread and severe degenerative changes in the various organs and tissues of the body before making a diagnosis or advising treatment, is just as culpable as to wait for the symptoms of general peritonitis before making a diagnosis of perforation in typhoid fever.

We have learned much from Kocher, of Switzerland, concerning the thyroid gland, but we have a Kocher in America and we are learning more from him. We have learned from Mayo that ether, properly given, can be safely used for anæsthesia in exophthalmic goiter, and that cases properly prepared, and not too far advanced in the disease, are safe operative risks. The ligation of the thyroid arteries is a procedure of great value, both as a mode of treatment in itself as well as a preliminary step in advanced cases producing such improvement in the general condition as to render the patients fit subjects for operation. Moreover, it renders operation easier.

Post-operative tetany has been shown by recent investigators to be due to interference with the function of the parathyroids which has to do with calcium metabolism. This dangerous complication can be controlled by intravenous or subcutaneous injection of extract of parathyroids as well as by the administration of calcium lactate, as shown by MacCallum and Voegtlin.

This much is certain, that the results both immediate and remote which Dr. Mayo has obtained in his work have placed the surgical treatment of exophthalmic goiter upon a safe and sound basis.

# URETERAL FISTULÆ AS SEQUELÆ OF PELVIC OPERATIONS

By JOHN A. SAMPSON, M.D., Albany, New York

## A CORRECTION

We regret that in the May number in publishing the above article by Dr. Sampson, the legends under Figs. 25 and 26 were reversed; also that Fig. 4 was printed so as to give an improper conception as to relations. They appear below correctly.

The word "week" in the fifth line, second column, page 487, should be "month."

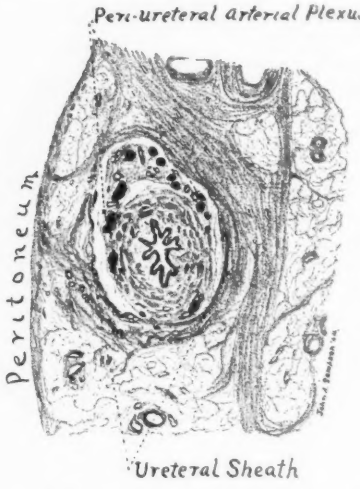


Fig. 4. Cross section of the ureter with peritoneum attached, 1.5 cm. above the entrance of the ureter into the parametrium. X 5.

From the same case shown in Fig. 5, but opposite ureter. The ureter by its peristalsis converts the tissue about it into a form of sheath, which in this situation is attached to the peritoneum; in freeing the peritoneum the ureter, with its sheath, is carried with the peritoneal flap thus formed. Within the sheath and loosely attached to the ureter, the periureteral arterial plexus can be seen in cross section, see Fig. 5. By freeing the peritoneum from the side of the pelvis the ureter can always be found attached to it if one wishes to locate it, but, if the peritoneum is accidently freed during an operation, there is danger of injuring the ureter. In an ideal uretero-vesical implantation the sheath and the peritoneum attached to it should be sutured to the bladder, in order to relieve any tension on the implantation and also to preserve the ureteral sheath and thus protect the ureter and its blood supply.

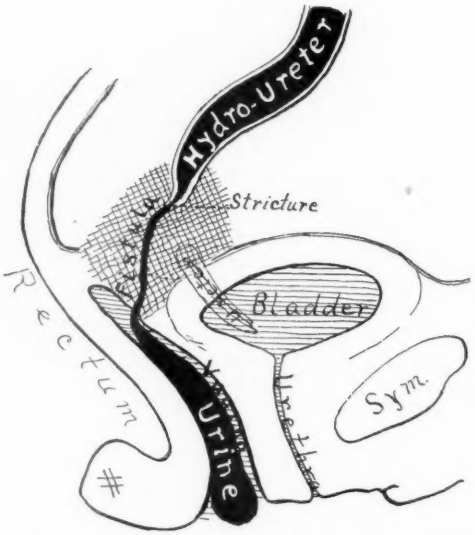


Fig. 24. Total uretero-vaginal fistula. Diagrammatic representation of one.

A stricture is always present after the fistula has persisted for a short time, and infection is often present. All the urine from the kidney escapes through the vagina except as the fistula may become temporarily or permanently occluded. On palpation one may often feel the induration about the fistula. On cystoscopic examination the ureteral orifice is "dead," urine does not escape and there is no motion about it. A ureteral catheter may be passed a short distance and on injecting colored fluid into the catheter it does not appear in the vagina but flows back into the bladder (a very exceptional case might occur where the severed ends of the ureter communicated with the vagina through separate openings). The fistula persists indefinitely and, if it heals spontaneously, it is only after a long period of time and with occlusion of the ureter and destruction of the function of the kidney.

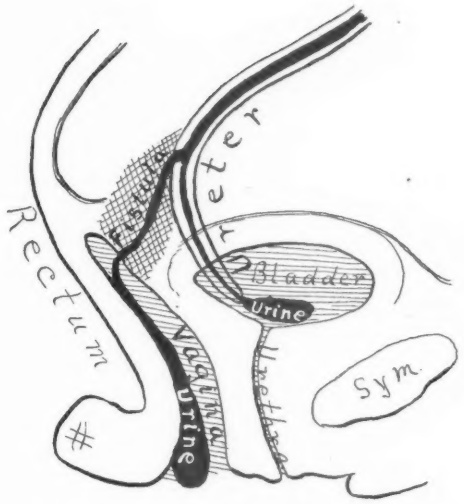


Fig. 25. Partial uretero-vaginal fistula. Diagrammatic representation of a partial uretero-vaginal fistula due to a lateral opening in the ureter.

A stricture may be present but often is very slight or entirely absent. The amount of urine escaping into the vagina and bladder varies with the size of the lateral opening and also the degree of patency of the ureter below the opening. On palpation one may often feel the induration about the fistula. On cystoscopic examination, urine may or may not be seen escaping from the orifice but if it is not seen, a "tug" will usually be noticed due to the contraction of the ureter above. A ureteral catheter may be passed beyond the opening, if a stricture is not present, and colored fluid injected into the catheter, whether the end of catheter is passed beyond the opening or not, will appear in the vagina. The fistula usually heals spontaneously, in a short time, and often with very little stricture formation.

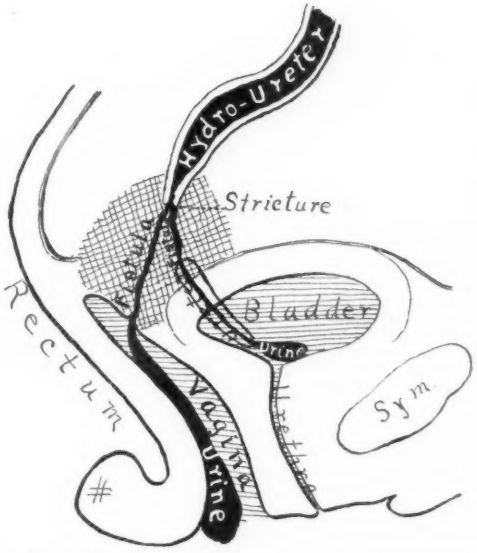


Fig. 26. Partial uretero-vaginal fistula. Diagrammatic representation of a partial uretero-vaginal fistula, in which there is a complete severance of the ureter with retraction of the cut ends but there is still a communication between these ends through a sinus, as well as a communication with the vagina. A stricture is always present if the fistula has persisted for any length of time. The symptoms and physical signs are similar to those of the preceding except that a stricture is always present. Such a condition probably exists for only a short time as either one or the other fistula will close, thus forming either a total uretero-vaginal fistula or a total uretero-vesical fistula. If the latter form persists the discharge of urine from the vagina ceases but the kidney is injured by the persistent ureteral stricture and eventually the stricture may close, thus destroying the function of the kidney.

# ABSTRACTS OF CURRENT LITERATURE

## DEPARTMENT OF GYNECOLOGY

UNDER THE CHARGE OF

J. Clarence Webster, M. D.
J. C. Hollister, M. D.
Gerry R. Holden, M. D.
E. C. Dudley, M. D.
Geo. De Tarnowsky, M. D.
Carey Culbertson, M. D.

**Operative Treatment of Vesico-cervico-vaginal Fistulæ.** (Sobre Tratamento das Fistulas Vesico–cervico–vaginæs.) Prof. Augusto Monjardino. *Jornal da Sociedade das Sciencias Medicas.* Lisbon, Portugal, 1908.

The author discusses the various operations for fistulæ between the bladder and the genital tract. The vaginal route usually offers difficulties on account of the distance from the introitus and the adhesions and induration which are usually present. Hence the suprapubic routes are coming into favor. Of these there are three.

1. Bardenheuer's Subperitoneal route, via the space of Retzius. The space available is so limited that operations are difficult and there is left a dead space in which exudates accumulate and are liable to infection.

2. Trendelenberg's transvesical route. This is most used, but the available space is very limited especially when the bladder is sclerotic, and in working blindly one is apt to injure the ureters.

3. Transperitoneal route. Dittel, 1892; Forgue, 1904. The author recommend this on account of the greater room; asepsis eliminates the danger in opening the peritoneum. Forgue opens the abdomen, lifts up uterus, and incises peritoneum transversely over back of bladder just below the level of the round ligaments, burrows bluntly down in the retrovesical tissues till he meets the fistula, recognized by the sclerosis about it, cuts this through and closes the vaginal and vesical ends. The author modifies this operation by turning down a peritoneal flap from below his transverse incision and insinuating it between the two closed end of the fistula, so as to prevent readhesion and reforming of the communication. The belly is then closed and a permanent catheter left in urethra for one week. He has used this method on three cases, the first with partial and the last two with complete success, and recommends this method as the most desirable for fistulæ high up the genital tract, especially when the site has been accurately located by cystoscopic examination.

In the discussion following this report, Dr Feyo e Castro described an operation he had devised for similar cases, by the vaginal route. He makes a transverse incision in anterior fornix, burrows up between bladder and cervix, locates, cuts and sutures ends of the fistula. He then resects the mucosa from below his transverse incision from the anterior vaginal wall over an area twice the size of the sutured fistulous tract, and folds this freshened part of the vaginal wall upward and interposes it between the two sutured fistulous ends and sutures it to both thus preventing their coming in contact with each other and reforming the communication. He has used this method with complete success in three cases. B. J. O'Neill, Jr.

**Concerning the Etiology and Therapy of Sterility in the Female.** Dr. Ernst Runge. *Archiv für Gynækologie*, Band 87 Heft 3.

The observations for this study were made by Runge in the clinic of Prof. Bumm, at the Universitat Frauen-Klinik in Berlin. Both Runge and Bumm believe that too much stress has been played upon gonorrhœa as the cause of sterility; and that there are important factors, in the development of the "genitalia," which must be reckoned with.

The investigations were conducted upon 66 *sterile* (i.e. failure of conception in 2½ years of married life) *Married women* and upon 17 *women who had borne children.*

In the 66 sterile women, *no* spermatozoa could be found in 51.5 per cent.; while in the 17 fruitful women, an absenec of spermatozoa was noted in 17.6 per cent.

The secretion was taken in all the experiments from *a* the posterior fornix, *b* the cervical canal, *c* the fundal portion of the uterus.

Great care was used not to carry any secretion from the cervix, up into the fundus.

SERIES NO. 1.

| Absence of spermatozoa in | Sterile Women per cent | Fruitful Women per cent. |
|---|---|---|
| Posterior Fornix of vagina | 77·7 | 25·5 |
| Cervix | 74· | 37·5 |
| Fundus uteri | 88.5 | 40 6 |

DEDUCTION

Sperm cells are found much less often in all three locations in the sterile women.

SERIES NO. 2.

| 6 hours after coitus Absence of spermatozoa in | Sterile Women per cent. | Fruitful Women per cent. |
|---|---|---|
| Posterior vaginal fornix | 56.7 | 0 |
| Cervix | 62.1 | 14.3 |
| Fundus | 78.4 | 0 |

| 12 hours after coitus No spermatozoa in | Sterile Women per cent. | Fruitful Women per cent. |
|---|---|---|
| Post. vaginal fornix | 82. | 23. |
| cervix | 80.3 | 30.7 |
| fundus | 93.4 | 23. |

| 36 hours after coitus No spermatozoa in | Sterile Women per cent. | Fruitful Women per cent. |
|---|---|---|
| Post. vaginal fornix | 95.6 | 25. |
| Cervix | 100. | 37.5 |
| Fundus | 91.3 | 75. |

DEDUCTION

From the above, we notice that a positive result is far less common in the sterile women.

The greatest difference between the two sets of women, was found, six hours after coitus, in the specimens taken from the post-vaginal fornix. We see, therefore, the *great importance* of the posterior vaginal fornix in the process of fertilization i.e., in receiving and retaining spermatazoa.

If the semen escapes readily, conception is difficult.

The fact that spermatazoa were found much less frequently in the cervix and uterus of the "*fruitful women*," was dependent very largely upon a poor "lac seminis."

Series III.

To find the rapidity with which the semen escapes from the posterior vaginal fornix, Runge experimented with vaginal infections of a colored gelatinous substance, of the same consistency as the semen.

He found that in the *sterile group of women* the fluid escaped in from 5–10 minutes, while a very considerable longer period was required in the second group of women (providing the latter had good pelvic support.)

GENERAL CONCLUSIONS

We conclude with Bumm, that sterility is very frequently due to poor development of the internal genital organs.

This under-development results

1. In a too rapid outflow of semen.

2. In a more or less stenotic cervical canal — especially at the internal os.

According to Bumm, Frankel, et cet., the poor vaginal development, results in diminution in the size and capacity of the fornices, especially the posterior fornix. This lessened capacity of the posterior vaginal fornix is also brought about by misplacements of the uterus; tumors in the neighbordood of the uterus, etc.

Furthermore the whole pelvic musculature is often poorly developed.

TREATMENT

1. We must overcome the narrow cervical canal.

2. We should endeavor to prevent a too early outflow of the semen, from the vagina.

To accomplish this,

*a*. Long continued tamponage may dilate the posterior vaginal fornix.

*b*. Massage.

*c*. Vaginal balloon with mercury may do good.

*d*. Some form of pessary may be useful.

*e*. The fornix can be enlarged by a plastic operation.

Finally, raising the foot of the bed during coitus will help to delay the outflow of the semen.

RALPH WALDO LOBENSTINE.

N. B. In all cases, the fresh semen — preferably secured in a condrum — should be carefully examined.

**Metastases in the Peritoneal Cavity in the Case of Carcinoma of the Uterus.** H. OFFERGELD. *Archiv. f. Gynækologie*, bd. 87, hft. 2.

Offergeld, after a general discussion of this subject, summarizes his deductions, which we present herewith "in toto."

1. Secondary growths in the peritoneal cavity are mainly found in the advanced cases of cancer of the uterus, occasionally in the early stages.

2. These secondary growths occur either by contiguity or by the lymphatics.

3. The situation of predilection are, Douglas' cul de sac and the dome of the diaphragm.

4. It is difficult to say whether in all cases the various growths are really secondary to a cancer of the uterus, or represent several primary growths.

5. The growths in the omentum and in the muscular layers of the intestines are of lymphatic origin.

6. The most common symptoms of these tumors are (*a*) the clinical development of an intra-abdominal tumor; (*b*) peritonitis (local or diffuse), and (3) stenosis of the gut. Often there are few if any symptoms.

THE LIVER

1. In cancer of the uterus, there are hepatic metastases in 5 to 15 per cent.

2. These may arise in any stage of the disease.

3. If the liver growth remains isolated, as the only metastatic tumor, it should be removed when the uterus is removed; therefore only an abdominal panhysterectomy should ever be done.

4. These liver tumors usually give but few symptoms.

5. They arise, in case of cancer of the uterus, viz.: (*a*) Through the blood-stream.

(1) Through the hepatic artery, after passing through the pulmonary circulation (very rare).

(2) Through the portal and the inferior hemorrhoidal veins, by direct extension into these vessels.

(3) Through the veins, which cause anastomoses between the inferior vena cava and the portal vein above the superior renal veins.

(*b*) Through the lymphatics.

1. Favorable for the localization in the liver is the fact, that the latter possesses two capillary systems (hepatic artery and portal vein); unfavorable, is the fermentative action of the liver, which destroys many embolic tumor cells.

2. Therefore liver metastases only occur with a decrease in its fermentative power and a general depression of the system.

THE PANCREAS

1. Metastases in the pancreas in the course of cancer of the uterus, is very rare.

2. It occurs only in advanced cases of carcinoma of uterus, and is localized mostly in the head of the pancreas.

3. It arises through the retroperitoneal lymph glands.

4. It develops either without symptoms or with the general symptoms of a tumor; therefore it is very seldom correctly diagnosed "in viva."

RALPH WALDO LOBENSTINE.

**The Influence of the Internal Secretions of the Ovary upon the Mammary Glands.** M. L. BOUCHACOURT. *Revue d'obstetrique et de Gynecologie*

Bouchacourt's conclusions from both clinical and experimental study, are the following:—

1. The ovaries may be considered, for the most part, as the chief exciting factor in the development of the mammary glands, outside of pregnancy.

2. That the ovaries may be regarded as secreting a substance, which at certain times, has a baneful influence upon the function of the mammary glands, would be borne, out by the following facts:—

a. The relative quiescent state of the ovaries, accompanying the increased hypertrophy of the breasts during pregnancy.

b. Ovarian castratian when not performed during lactation is accompanied by a temporary congestation of the breasts.

c. This same congestion of the breasts is at times seen in the normal menopause.

d. Pregnancy during the period of lactation has a rather favorable influence on the lactation.

e. Ovarian castration during lactation tends to prolong the latter and to improve the quality of the milk.

f. Menstruation during lactation, shortens the latter and frequently diminishes the quantity and lowers the quality of the milk.

g. Nymphomania in the domestic female animals decreases the power of proper suckling their young.

The practical deductions to be drawn from the above are (*a*) As the ovarian function is stimulated by sexual excitement it is an advantage to the nursing woman to have little or no sexual relation during the period of lactation. As the advent of the menses nearly always changes either the quantity or the quality of the milk, it seems wise to substitute modified cow's milk at several feedings during the twenty-four hours. During the act of menstruation the breast-milk may be *actually* poisonous to the child.

(*b*) Although the prevailing teaching exists that if a nursing woman becomes pregnant she should, at once, stop the nursing, because of the bad effects upon the "suckling," this opinion has repeatedly been shown to be false. The danger — if danger exists — is not to the child, but to the mother or wet-nurse. Nursing should not be stopped during the earlier months of an intercurrent pregnaney providing the mother's health is good. The mother or wet-nurse should receive an abundant, wholesome diet. Mixed feeding of the infant may be used, if desired. In the case of animals, it was clearly shown that pregnancy intervening in the course of lactation, has a tendency to improve the quality of the milk. Furthermore, castration of an animal during lactation, prolongs the latter and tends to improve the milk.

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In twenty-nine cases, observed by Capart, only two of the sucklings apparently suffered as the result of the intercurrent pregnancy.

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**Maligant Disease of the Uterus.** LOUISE GARRETT ANDERSON AND KATE PLATT, *Jour. of Obst. and Gyn. of the Brit. Emp.*, Dec., 1908.

This article is a digest of 265 cases from the records of the new Hospital for Women, London, extending over the past thirteen years.

Of the twenty-nine patients operated upon by visginal hysterectomy for cancer of the cervix, one a known to be alive and well seven years later. Ih two cases health was maintained for two years, but in twelve the disease recurred very soon after the operation. The other patients have been lost sight of. These cases were all operated upon prior to 1902, since which time the abdominal route has been chosen.

The after results of 58 abdominal hysterectomies for cancer of the cervix are less discouraging. Twenty-six patients were known to be alive and well between one and one-half and four years after their operations. Seventeen women developed recurrence within three and one-half years, eleven during the first year; fifteen cannot be traced.

The fundus was the site of malignant disease in forty-eight patients, thirty-nine of whom were treated by hysterectomy, nine by the vaginal route and thirty by the abdominal. Of these thirty-nine, twenty-two have remained well during periods of from two to seven years; seven developed symptoms of recurrence in from one to five years; three died; seven cannot be traced.

Of the tumors of the cervix, there were 216 cases of which ninety-three were squamous-celled carcinomata, twenty-four were adeno-carcinomata, ninety-three were of unspecified variety, two were sarcomata, four were endotheliomata. Of the tumors of the fundus there were forty-eight cases, of which thirty-seven were adeno-carcinomata, one was a chorion-epitheloma, ten were sarcomata. Of these forty-eight also, seventeen were associated with fibroids, while this complication occurred in but four of the cervix cases.

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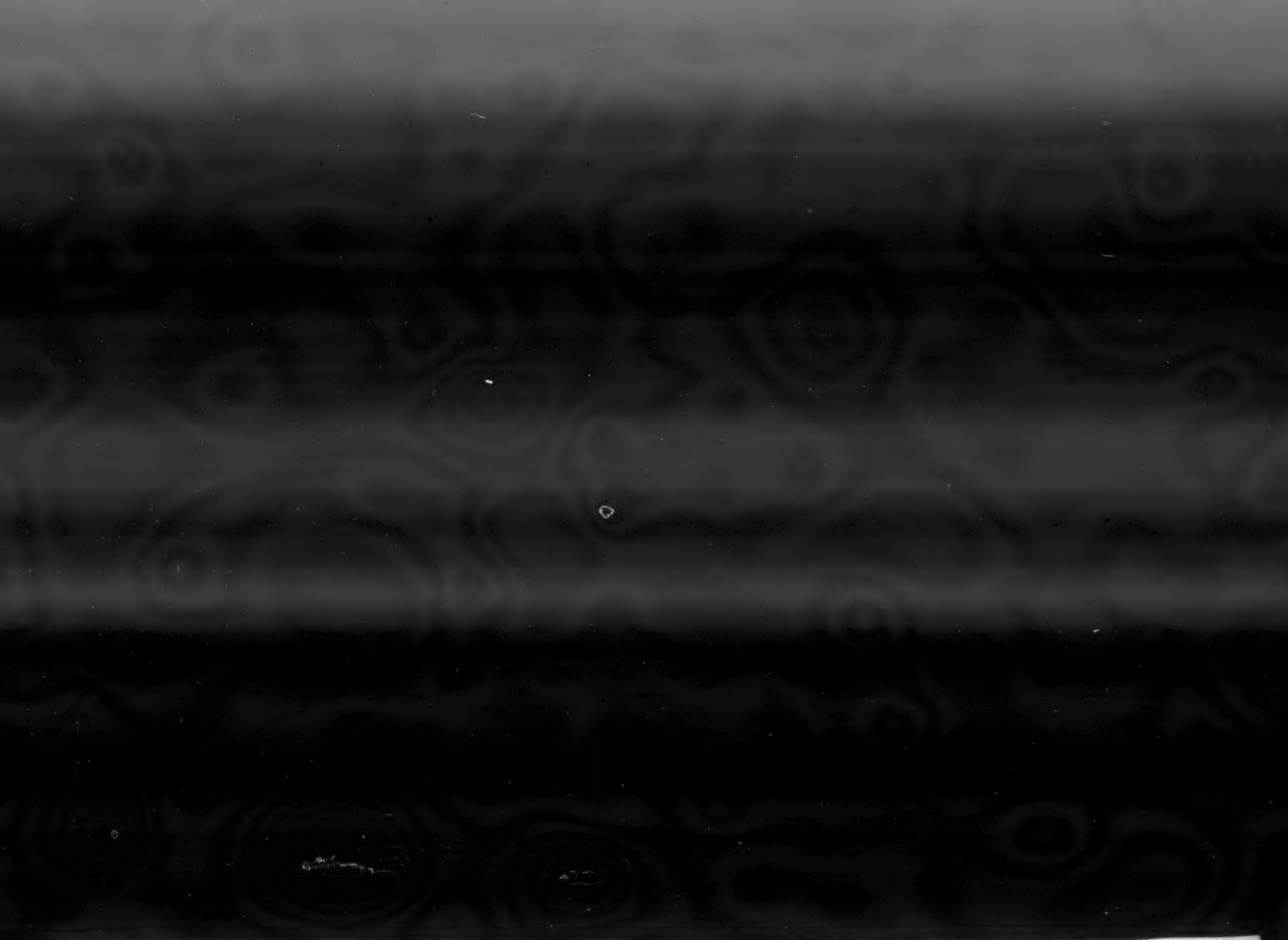

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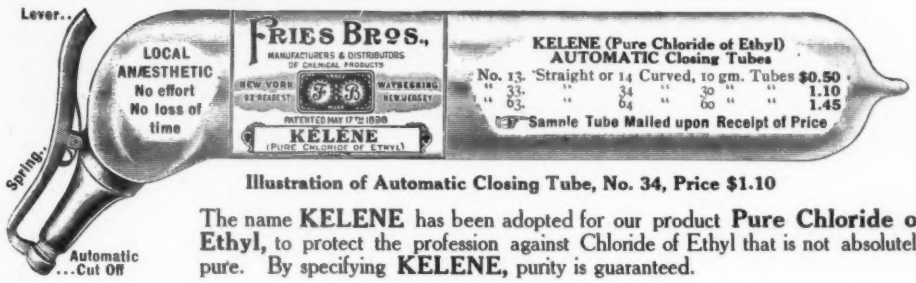


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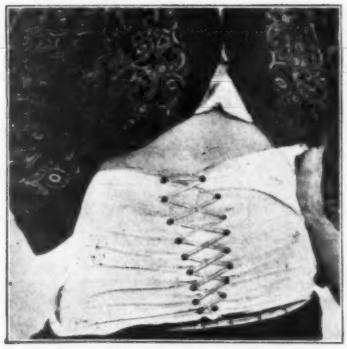

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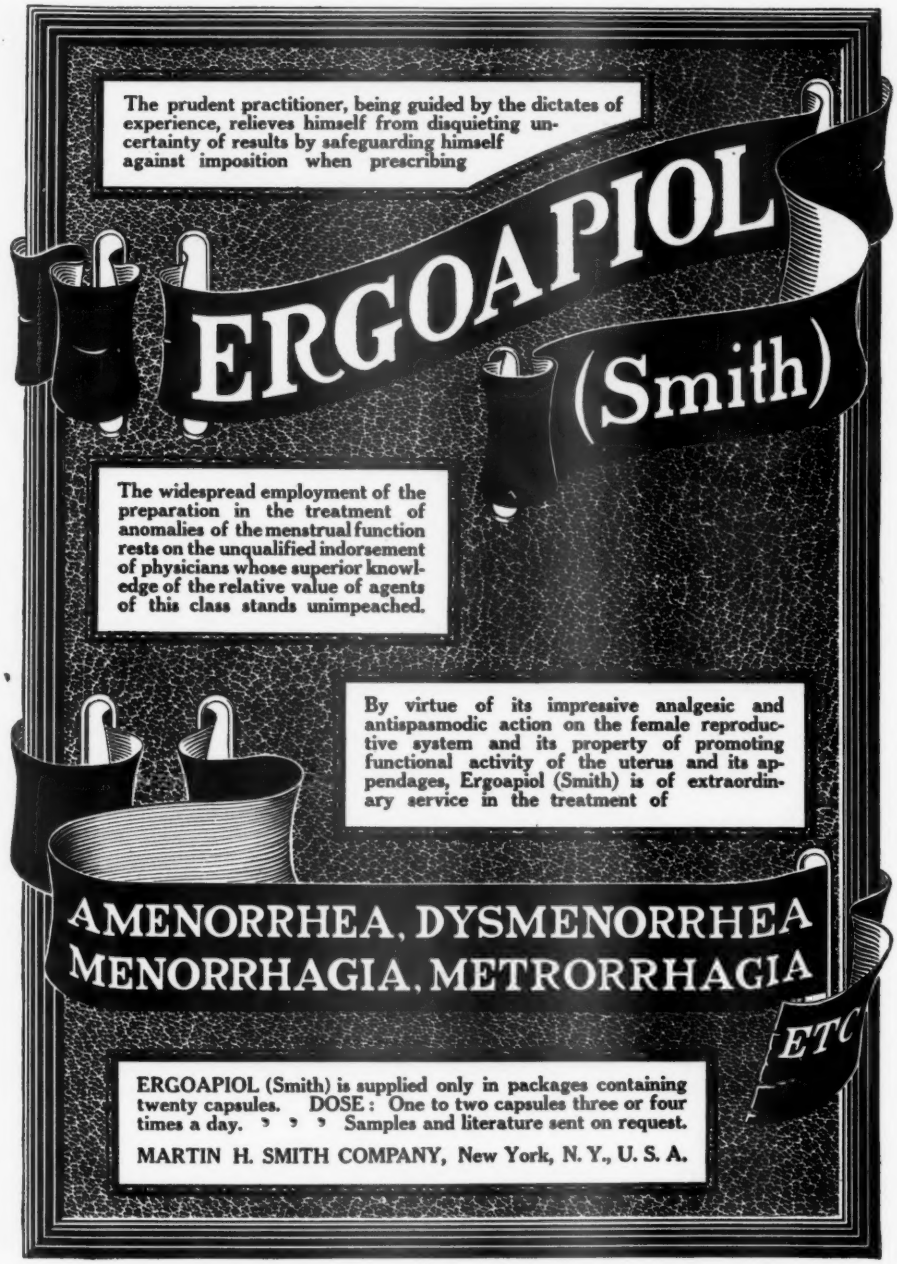
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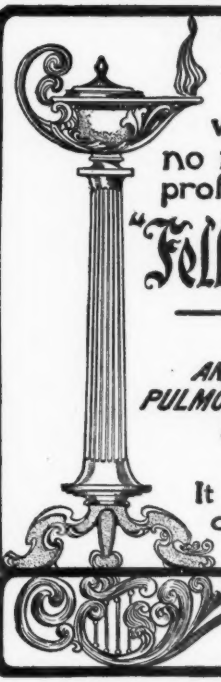

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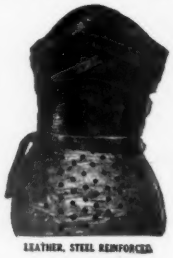
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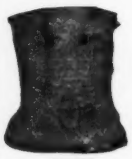
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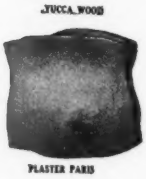
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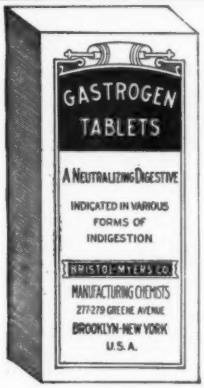

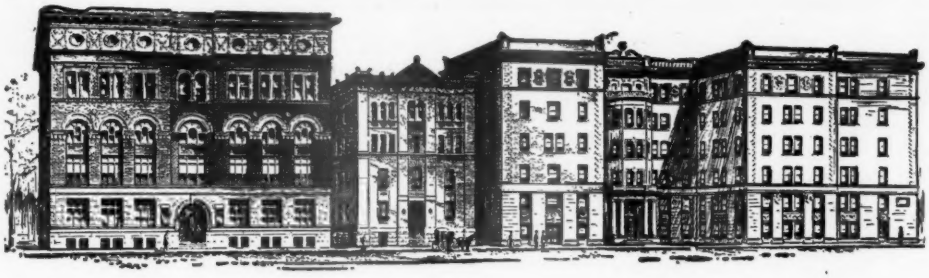

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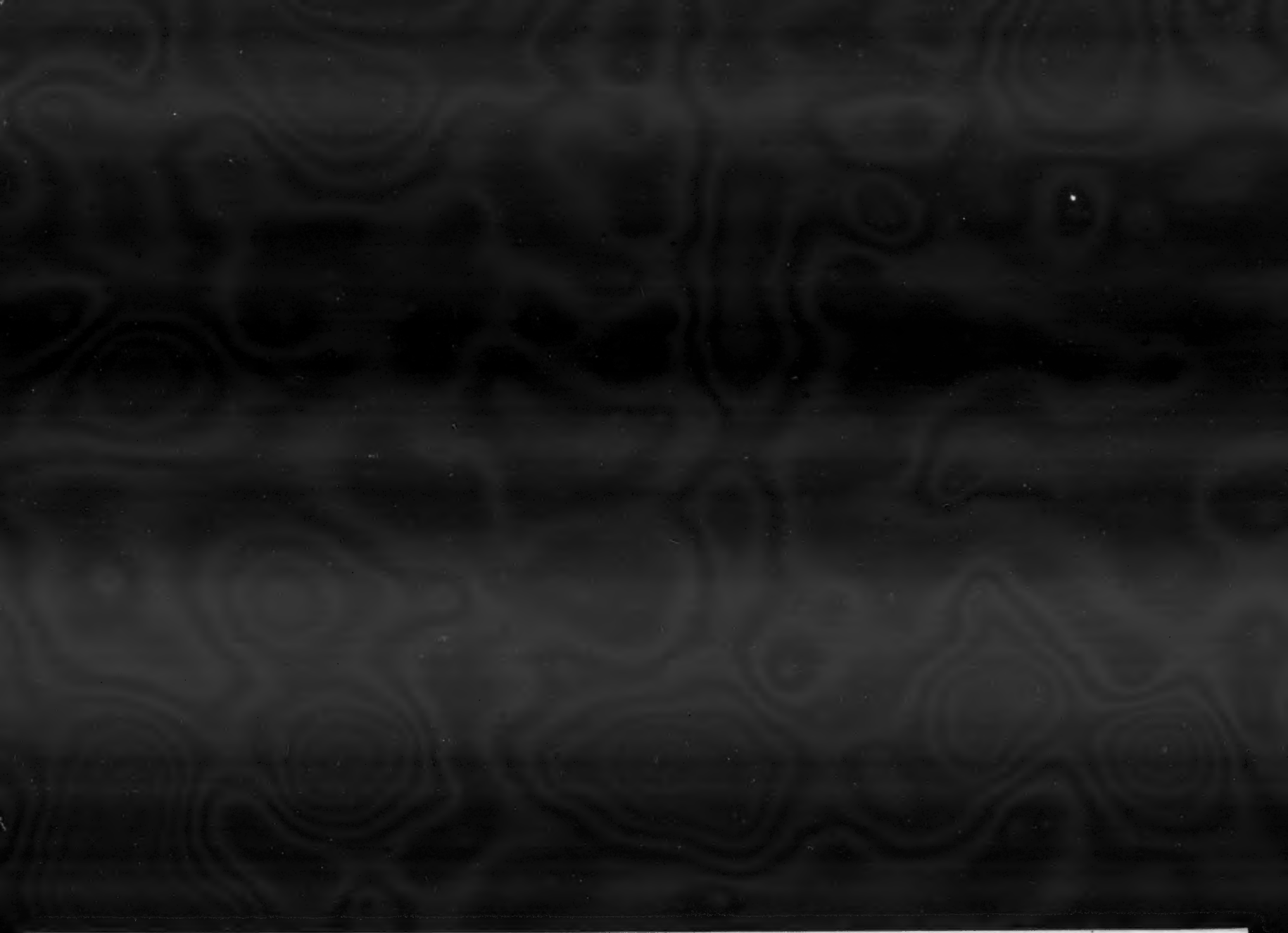

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